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APPLIED HYDRAULICS

APRIL 1956

THE MAGAZINE OF FLUID POWER
including Air Controls, Air Circuit Design and Electrical Controls...

Hydrostatic Drive on a Lift Truck . . . page 57

Electric Motors for Pump Drives . . . page 59

Mechanically Actuated Air Pilot Valves . . . page 63

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Speed and Torque from Hydraulic Transmissions . . . page 75

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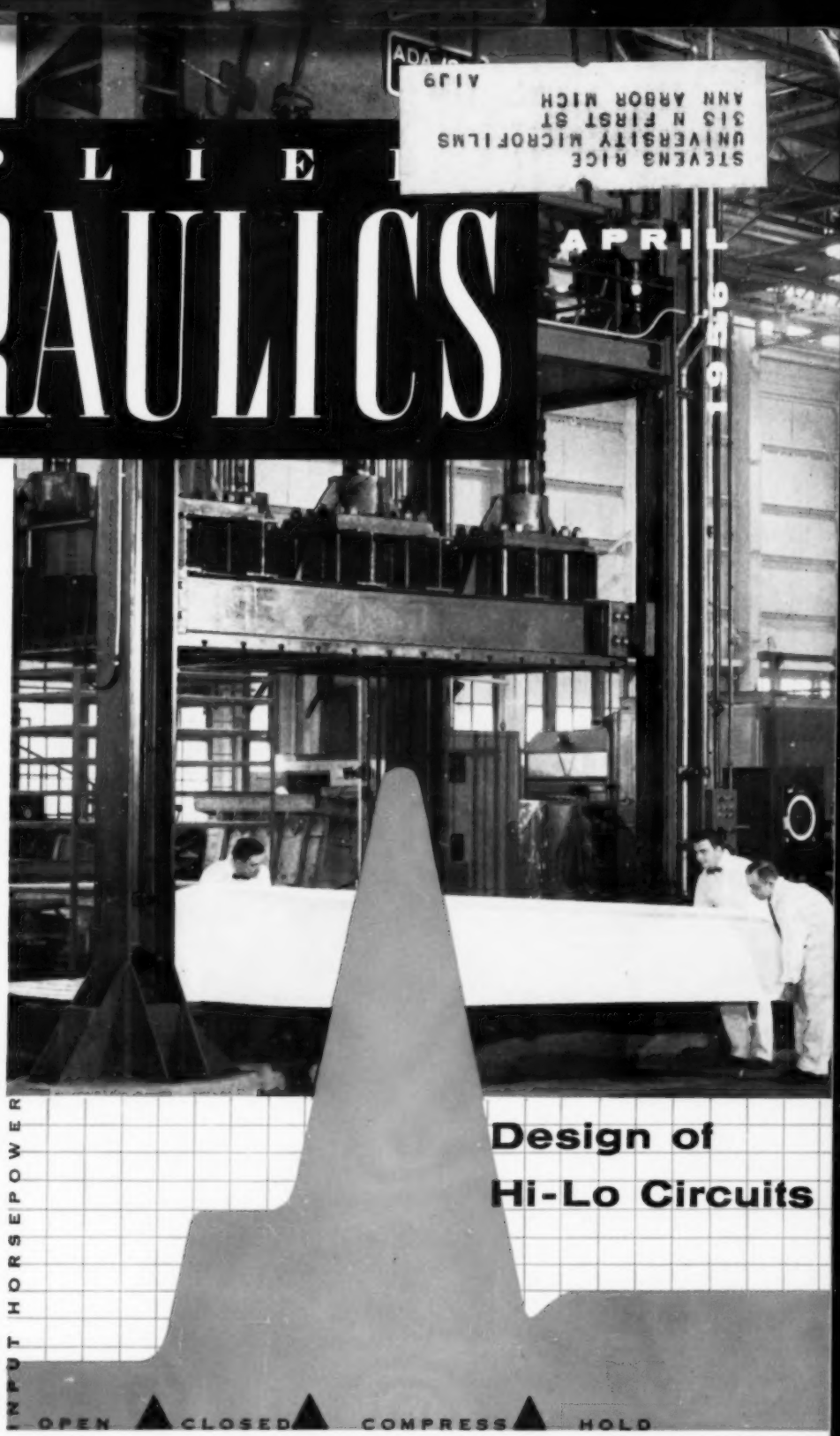
FRANCHISE CIRCULATION



Design of Hi-Lo Circuits

For information about the
1956 APPLIED HYDRAULICS Prize Paper Contest
See page 10

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FOR EACH PARTICULAR
TYPE OF APPLICATION

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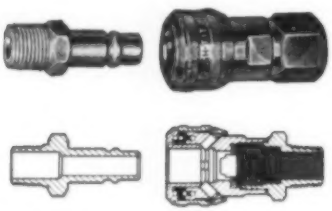
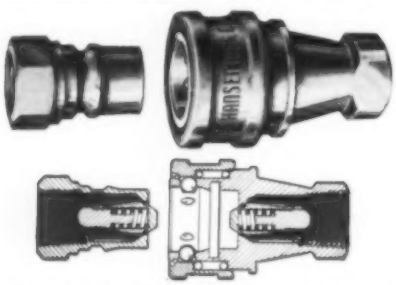
QUICK-CONNECTIVE COUPLINGS



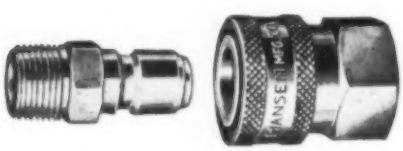
ONE-WAY SHUT-OFF
Shuts off one side of line

Gives quick connection and disconnection, with instant automatic flow or shut-off. To connect Coupling and open line to flow of fluid, merely push Plug into Socket. To disconnect, a slight pull on sleeve releases Plug and shuts off supply end of line.



TWO-WAY SHUT-OFF
Shuts off both sides of line

To connect, pull back sleeve and push Plug into Socket. Identical torpedo type valves permit free flow of gas or liquid through Coupling. To disconnect, pull back sleeve . . . Coupling immediately disconnects, valves automatically seal both ends of line. Female pipe thread connections from ⅛" to 1". Available in brass or steel.



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Provides quick connection and disconnection, but does not have shut-off feature. Sizes, ranging from ¼" to 2½", carried in stock. Two special types of straight-through steam Couplings also available—one for low pressures, and one for high pressures.

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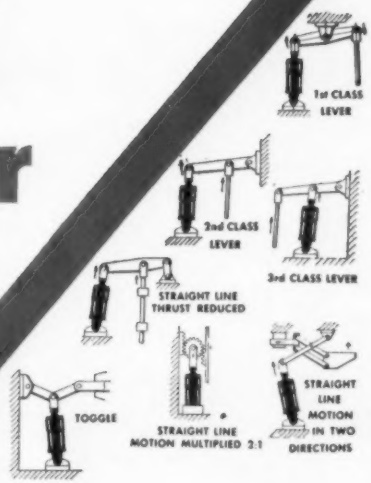

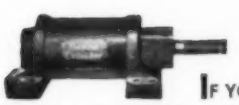

IF YOU HAVE a push, pull, lift, press, clamp or control problem, Hanna Cylinder Power can be the answer. The mechanical movements here illustrated may suggest ways Hanna Cylinders can be used to simplify the actuation and control of machines or equipment and to replace or reduce manual effort.

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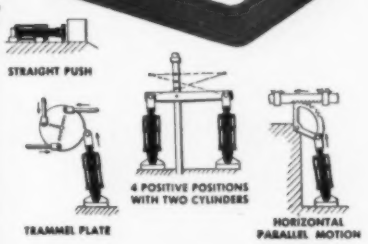

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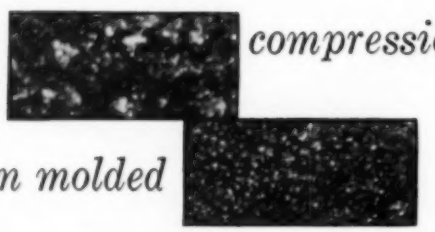
answer: *minnesota rubber and gasket company*

evidence:



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APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER

APRIL 1956
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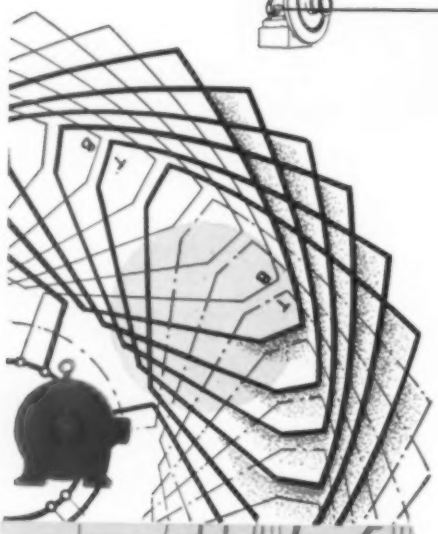

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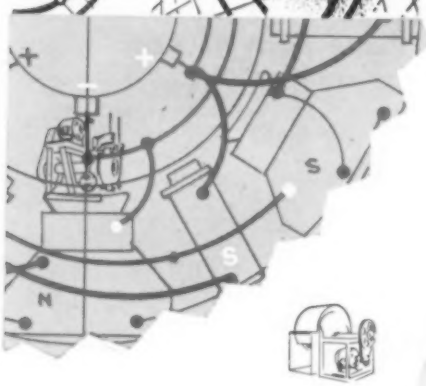

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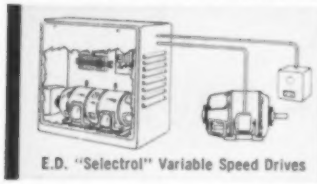

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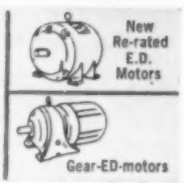

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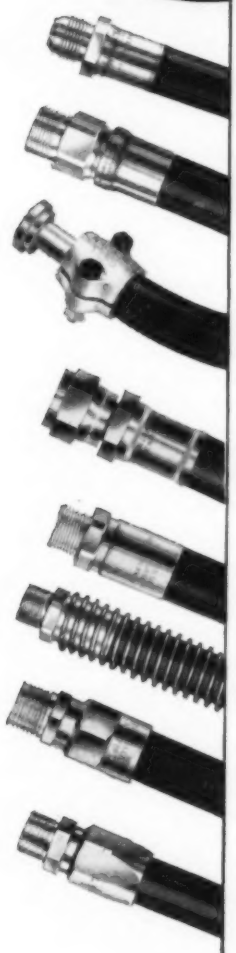

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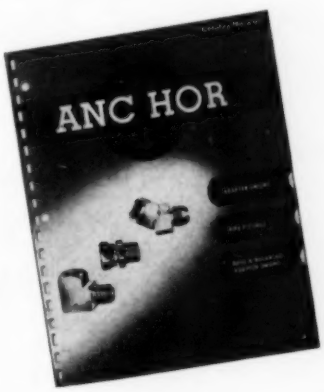

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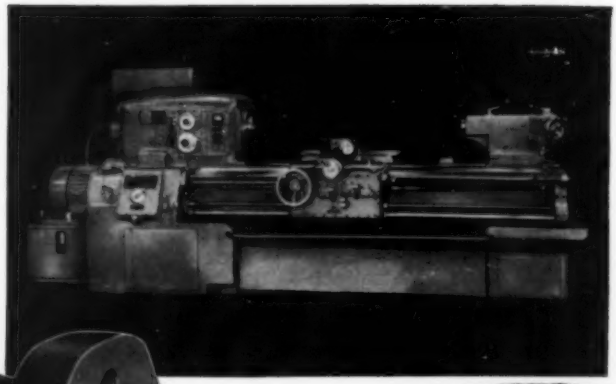

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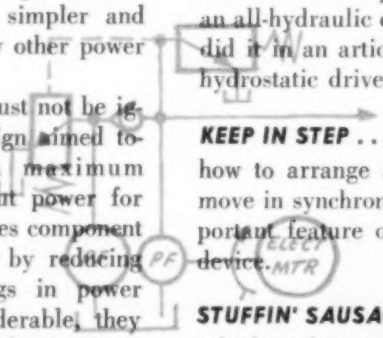
Fluid Power Lines

about Applied Hydraulics

FLUID POWER EFFICIENCY . . . Is a hydraulic system good, bad or indifferent when it comes to comparing its efficency with that of an electrical or mechanical system? This is an impossible question to answer simply. This month's lead article, "Design of Hi-Lo Circuits" gives a large part of the answer.

The important point is this: Between the horsepower input to the pump and the power output at the load, there can be and usually are many power losses in the hydraulic circuit. Hydraulic power is seldom chosen because of power savings—it is chosen because it can supply the required forces and speeds in a package which is simpler and less costly than any other power source.

But efficiency must not be ignored. Careful design aimed toward utilizing a maximum amount of the input power for useful work increases component life and reliability by reducing heat. While savings in power costs can be considerable, they are often incidental by comparison to lower maintenance costs.



ELECTRIC MOTORS . . . You can't hardly drive a hydraulic pump without one. Most industrial hydraulic systems use a 3-phase squirrel-cage induction motor because this motor is simple and economical. This month, our second article in a series which details the selection of electrical components for fluid power systems tells how to select a motor for a hydraulic drive.

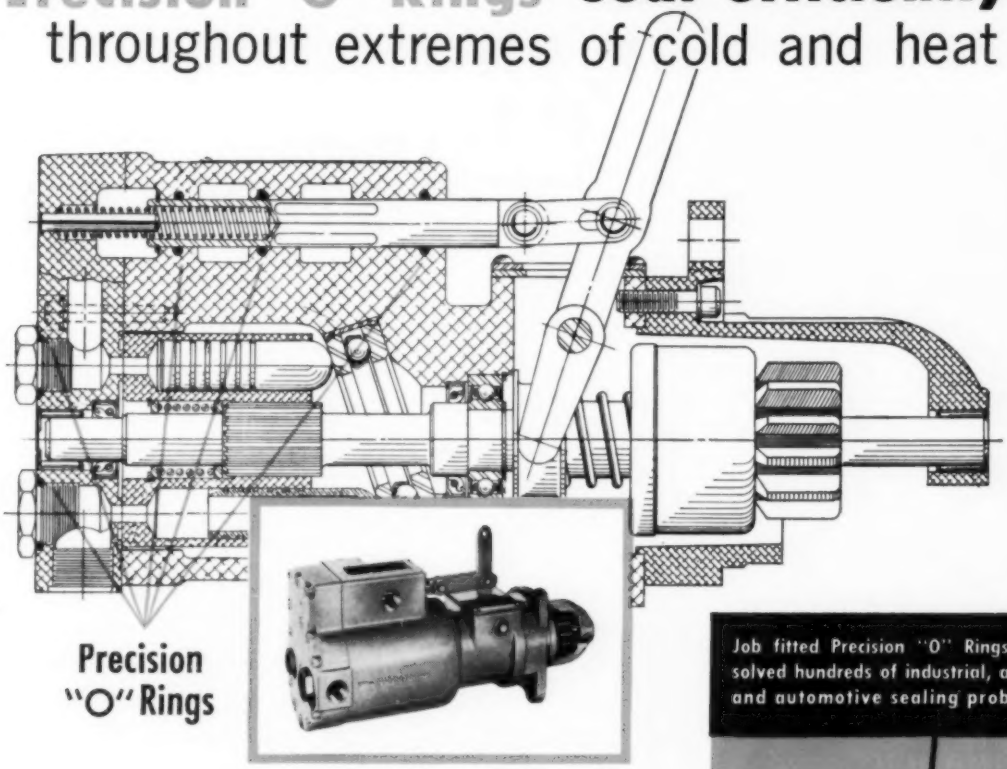
ROUNDTABLE TALKS . . . We're glad to credit King Arthur with the origination of roundtable discussion. The idea undoubtedly goes back way before his time too, but anyway we all agree that discussing things at a roundtable is an old idea which can often be fruitful. So take a seat at the roundtable which gets started on page 83. And if you get the urge to add your comments to the discussion just jot them down and send them to us. We'd like to include you in.

LESS MAINTENANCE, LOWER COST . . . Here's a surefire sales pitch, if it can be proved. Buy a machine for less cost, have less maintenance and do the same job as the competitive equipment. How could you miss with a design like that? Next question—How do we do it? Designers of an all-hydraulic drive for an industrial truck tell how they did it in an article on page 57. Is there a big future for hydrostatic drives?

KEEP IN STEP . . . Bob Raymond's article in this issue tells how to arrange and select two cylinders to get them to move in synchronism over a 13 foot stroke. An added important feature of this circuit is the overload protection device.

STUFFIN' SAUSAGES . . . Ever wonder how it's done? Take a look at the story on page 63. The air powered machine, used to form and package sausages, has a couple design ideas which you may be able to use. Even if you only eat sausages, and even if you don't like them, you'll be interested in this machine design problem.

Precision "O" Rings **seal efficiently** throughout extremes of cold and heat



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Co-authorship is approved, a number of winning papers have been co-authored. Discuss your choice of subject with your department head and begin to make your plans. Early entrants have won a good share of major Prize money.

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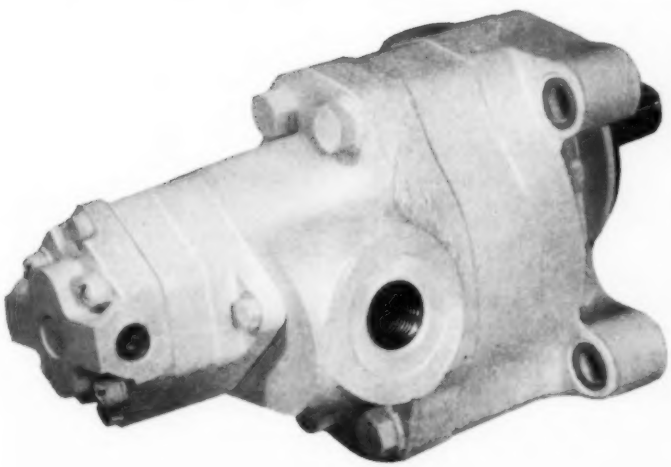
CUT COSTS FOR POWER STEERING
and other Dual Applications

Webster Tandem Pump Combinations were developed especially to meet the demand for power steering on vehicles such as lift trucks, farm and construction equipment. They provide opportunities for substantial savings in all applications where two separate hydraulic power circuits are to be served.

Webster's Tandem Pump Combinations can be furnished in a wide range of capacities. For example, for 1750 rpm installations, capacities of the larger pump in the combination can range from 4.8 to 29.0 gpm at 1000 PSI. The smaller pumps, normally used on power steering applications, have a capacity range from 1.0 to 4.0 gpm at 1000 PSI.



This new Webster development reduces installation and equipment costs in many ways.

For example:

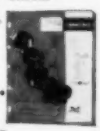
Only one driving medium • Shafts of the two pumps are mated to operate from a common driving medium, thus eliminating the cost of a second drive unit.

Less hydraulic piping • The two pumps have a common inlet, thus reducing the amount of hydraulic piping required.

Adaptable • If only the large pump is required initially, this can be supplied with a cover plate, which enables later addition of the smaller pump without additional inlet piping.

Compact design • Eliminates many installation problems and reduces installation time. Overall lengths of typical combinations range from 8¾" to 10⅛".

The unique design of Webster pumps provides greater flexibility—enables us to adapt standard units to solve most special problems—thus making substantial savings for you. And you get the quality construction and advanced engineering characteristic of Webster's complete line.



OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE • WISCONSIN

Write today for complete information

☐ Please send us complete information on new Webster Tandem Pump Combinations

☐ Please send catalog on complete Webster line

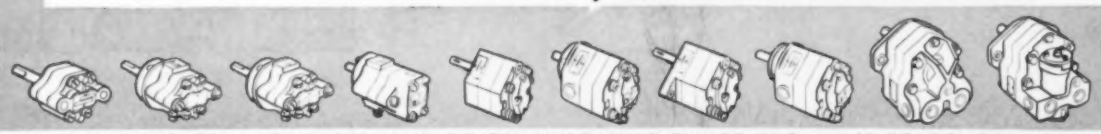
Name_____

Title_____

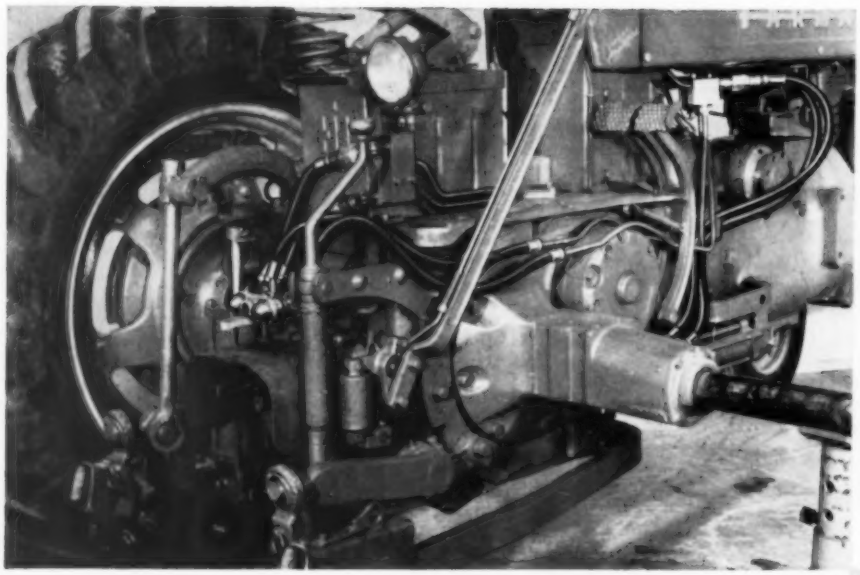
Company_____

Street_____

City, Zone & State_____



MANUFACTURERS OF A COMPLETE LINE OF OIL HYDRAULIC PUMPS FROM 1/5 TO 30 GPM CAPACITY



INTERNATIONAL HARVESTER'S
McCORMICK FARMALL 400
Tractor controls every implement action hydraulically through its famous Hydra-Touch hydraulic system. Individual, closely grouped levers permit independent or unison control of cylinders.

HYDRAULIC POWER . . . DELIVERED THROUGH

Eastman

HYDRAULIC HOSE ASSEMBLIES . . .

Most competitive Farm Implement Sales Feature

HYDRAULIC POWER probably contributed more to the usefulness, efficiency, and easy operation of farm tractors than any other modern engineering development. Farmers appreciate hydraulic advantages so much that they have become one of the *most competitive features in implement and tractor sales promotion.*

EASTMAN MANUFACTURING COMPANY is proud to have among its many agricultural users the International Harvester Company—dating back to the first McCormick Reaper—in 1831. Eastman—*first in the field* of Hydraulic Hose Assemblies—lists many other agricultural implement manufacturers among its users: J. I. Case, Allis-Chalmers, Massey-Harris-Ferguson, Inc., Minneapolis-Moline, Farmhand, Avco, and others.

IMPROVE THE COMPETITIVE POSITION OF YOUR PRODUCTS with Hydraulic Power—delivered through Eastman Hydraulic Hose Assemblies. Always specify Eastman: First in exclusive engineering advantages and design! First in materials and workmanship! *First in the field* of Hydraulic Hose Assemblies!

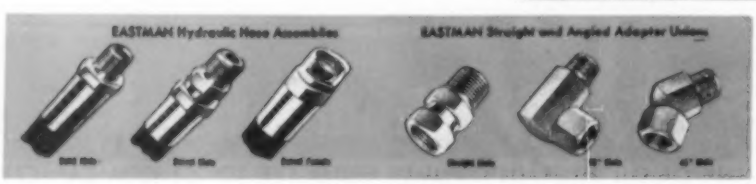
WRITE **Send your specifications and blueprints for our original equipment quotations.**

HYDRAULIC POWER controls plow penetration and depth automatically, lifting and locking in traveling position.

HYDRAULIC POWER controls angle and depth of disc penetration on International Fast-Hitch Bush and Bog Harrow.

HYDRAULIC POWER enables Farmall 200 Hydra-Creeper to travel 1/5 to 1 mile per hour for transplanting.

HYDRAULIC POWER permits raising right, left, or rear cultivator gangs separately, together, or any combination.



Eastman
first in the field
MANUFACTURING COMPANY
Dept. AH-4, Manitowoc, Wis.

LETTERS
to the editor

Engine Throttle Control

We are using a hydraulic throttle control of our own design to automatically advance the engine throttle when the hydraulic pump is loaded, on truck-mounted equipment of our manufacture. This device consists of a tiny spring loaded hydraulic cylinder connected to the pressure output of the pump.

As a cost reduction measure, we would prefer to purchase this control. Can you supply the name of a manufacturer offering such an item?

LESTER L. MYERS
Chief Engineer
Mobile Aerial Towers, Inc.
Fort Wayne, Indiana

Perhaps our readers have an answer for you. Have you checked the catalogs of cylinder manufacturers to see if an available single-acting cylinder could be adapted for your job? We've sent you a list of cylinder manufacturers.

Master Catalog Tech Section

We've had a number of requests for copies of the 180 page Technical Section of the Master Catalog of Fluid Power Products which was published in October 1955. No part of the Catalog is available separately. Complete copies are still available at $6.50 each.

Sluggish Systems

I have been told that an article appeared in one of your recent issues on the sluggishness in hydraulic systems due to contamination of hydraulics fluid. I believe this article was published in connection with a JIC meeting in 1954.

FRANK H. GILDNER, JR.
General Purpose Control Dept
General Electric Company
Bloomington, Ill.

In the November 1954 issue the article, "How to Care for Hydraulic Oils" was authored by John R. McCoy. In the July 1954 issue

Continued on next page

Shenango
CENTRIFUGALLY CAST COMPONENTS

...for exceptional performance in hydraulic service

SHENANGO offers specialized production of cylinders and all other symmetrical components, small or large, ferrous or non-ferrous, rough machined or finished to your specifications. Produced by the Shenango centrifugal casting process, they assure:

- **Uniform, *pressure-dense* grain for greater strength and superior wear resistance . . .**
- **Freedom from inclusions and avoidance of porosity . . .**
- **A minimum of machining and faster finishing with excellent surface characteristics.**

Find out if Shenango specialization can spare you cost and trouble. Get acquainted also with Shenango centrifugally cast tubular *stock* available in a broad range of diameters and lengths. For helpful bulletins or engineering service write Shenango-Penn Mold Company, Centrifugal Castings Division, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE® METAL • ALLOY IRONS

Circle 95 on Reader Service Card

the **NEW**

USG **SOLFRUNT®**

(SOLID FRONT CONSTRUCTION)

the gauge with

BUILT-IN SAFETY!

There's safety with the new USG Solfrunt Gauge . . . behind the face is a solid metal wall! In the event of a Bourdon tube rupture, pressure is released through the large rubber blowout back. The case is of aluminum.

Like USG's Supergauge . . . with proper application . . . the Solfrunt is built to last a lifetime.

ARC-LOC MOVEMENT—Rugged beyond compare . . . broad generated gear faces, deep stainless steel bushings. Calibration adjustments from rear by merely removing blowout back.

SEGMENT—Stainless steel, with nylon-faced gear section. Nylon-to-metal bond stabilizes the nylon against expansion and contraction . . . maintains accurate pitch diameter . . . assures proper mesh with stainless steel pinion under severe temperature and moisture conditions.

LEGEND ON DIAL—gives complete description of socket, Bourdon tube, and movement material for ready identification.

MICROMETER ADJUSTABLE SELF-LOCKING POINTER—permits accurate repositioning of pointer.

Solfrunt Gauges available in 4½", 6" and 8½" sizes. For complete information on case styles, materials of construction and connections, write for Publication 1819.

UNITED STATES GAUGE

Home of the **SUPERGAUGE**

Gauge Headquarters FOR OVER 50 YEARS

Division of American Machine and Metals, Inc., Sellersville, Pa.

LETTERS to the editor

a report of the Machine Tool Hydraulics Forum gave some information on the problem of oil contamination.

You'll find sources of material concerning this problem in the January 1956 *issue of* APPLIED HYDRAULICS *which is a complete index of articles published in the fluid power field since* 1931 *in all technical publications.*

Spring Loaded Accumulator

We are looking for a manufacturer who makes a spring operated accumulator for hydraulic systems. We operate at 500 to 600 psi and flow of 45 gpm with the cylinders operating 4 to 5 cycles per minute.

C. J. WILKERSON
Concrete Products Co.
Tucson, Arizona

We are of the opinion that spring loaded accumulators of this size went out with high button shoes. A spring loaded accumulator for your job would be very much bigger and weigh very much more than a hydropneumatic type. Undoubtedly, spring loaded accumulators of the size you want can be made. Maybe a reader will tell us who could build one for you.

Electric Controls

I have read with interest your article "Electrical Components for Fluid Power Equipment" in the February issue. This article shows electrical symbols which have been adopted by the Joint Industry Conference. Can you advise me where I can get copies of JIC Standards for electrical, hydraulic and pneumatic equipment?

Are JIC standards authorized by the American Standards Association.

H. B. DOLL
Read Standard Corp.
York, Pa.

JIC Standards may be obtained by writing the Joint Industry Conference, Box 182, *North End Station, Detroit* 2, *Michigan. At the*

Continued on page 16

ANOTHER NEW HOUGHTON DEVELOPMENT IN PACKING DESIGN

HOMOGENEOUS RUBBER | FABRICATED RUBBER | LEATHER

STANDARD STACK HEIGHT

for "V" Packings

Good news for the designer! This new packing development standardizes the stack height of *all* Houghton "V" packings. Simply determine the number of packings needed in the gland (according to your pressure requirements) . . . then allow for the specified dimension in your drawing. Whether you use homogeneous rubber, fabricated rubber or leather "V's" . . . they'll fit!

You can forget "special" dimensions set up by various packing manufacturers for particular types of packings. Standardize on stack height with packings from Houghton and you'll save time and money from the drawing board on!

The leadership in hydraulic know-how is typical of Houghton, which supplies all types of hydraulic and pneumatic packings, as well as a complete line of hydraulic oils and fluids.

Standardize on Houghton. You'll get the newest first—and the best always. Call your Houghton Man and let him explain Houghton's Hydraulic Service. E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

. . . product of

E F HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

FLEX-O-TUBE®

When you specify Flex-O-Tube for flexible lines you get the utmost in *dependability* as well as *bendability*.

Manufacturing facilities are keyed to precise production control. This means you can depend on Flex-O-Tube delivery dates . . . and that's mighty important when you're working against tight production schedules.

Every needed inspection and testing facility is on hand at Flex-O-Tube to safeguard the high quality standards of every product shipped. You can depend on Flex-O-Tube performance.

Dependable, too, is the engineering counsel we gladly extend when you're developing new flexible hose products. This engineering know-how is based on more than twenty years in the business.

If there's a flexible line in your product to conduct air or liquid, that has to be bendable, call in Flex-O-Tube . . . it's dependable.

3080

Supplied in Assemblies

Flex-O-Tube will help you determine the assembly needed or work to your own specifications. In either case, modern facilities and latest inspection techniques assure you a uniformly high quality product delivered promptly.

Supplied for Field Assembly

Flex-O-Tube hose is also supplied in bulk coils with reusable fittings for field assembly. Complete range of sizes and types.

Please send me your free ☐ aircraft catalog. ☐ industrial catalog.

Name .....

Company .....

City ..... Zone ..... State .....

Address .....

FLEX-O-TUBE

DIVISION OF MERIDAN CORP.

2527 JIM DALY ROAD • INKSTER, MICHIGAN

Flex-O-Tube Co. (Canada) Ltd., Windsor, Ontario

LETTERS to the editor

present time JIC drawing symbols are not authorized by American Standards Association; however, work is being done by an ASA committee to incorporate JIC hydraulic symbols into their standards.

January Index Issue

In view of the fact that you have published the Master Catalog of Fluid Power Products, I have been wondering what you were going to do with the January issue, which has been a Directory issue in the past. The January 1956 Index issue has arrived and the question has been answered.

I think the engineering index is a worthwhile idea and it has been very well carried out. In view of the fact that the index covers a period of from 1931 to date, I am wondering whether it is possible or desirable to make this index an annual affair. What are your plans?

JOHN G. SPOTTON
John Spotton Co. Limited
Toronto, Canada

Our plans for future issues of the Engineering Index depend on two things. Most important is our readers' interest. It appears to be good. We have already had orders for hundreds of additional copies. Another factor is the amount of new material each year. We will keep the index up-to-date and as it grows we will be able to determine when it is most practical to publish another index.

Air Cylinder Knowledge

We are interested in mechanizing our machines with the use of air cylinders, and would appreciate it if you could recommend a good handbook on the subject.

P. W. HELLIGE
Saco Manufacturing Company, Inc.
Saco, Maine

Your best information about air cylinders is in Elmer Heiser's book "Air & Oil Cylinders in Industrial Applications". This excellent book can be ordered from us. The price is $5.00.

Continued on page 18

BIGGER THAN YOU THINK

Skinner solenoid valves are compact, tiny and lightweight.

But don't be misled — they'll easily outperform other valves that are much larger and heavier. Built to withstand high voltages and temperature extremes, Skinner valves provide leakproof, trouble-free operation through millions of cycles.

And being small, they are easily adaptable to your most compact equipment design. Call in a Skinner engineer on all your valve problems *first*. He can draw from over 100,000 variations . . . all of them *big in capacity, power and performance.*

Write for the new Skinner Solenoid Valve Catalog. On your letterhead, please.

SKINNER SOLENOID VALVES

THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION • SKINNER CHUCK COMPANY

105 Edgewood Avenue
New Britain, Conn.

WORLD-WIDE REPRESENTATION

Circle 97 on Reader Service Card

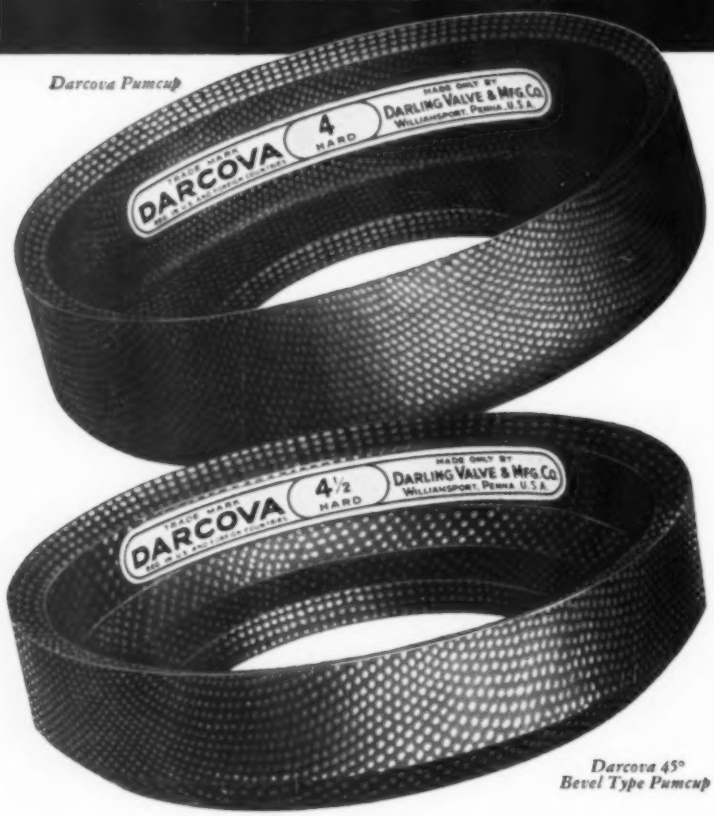
DARCOVA PUMCUPS

now available with

100% NYLON COMPOSITION

for HYDRAULIC CONTROLS, AIR CYLINDERS, RECIPROCATING PUMPS

Darcova Pumcup



Darcova 45° Bevel Type Pumcup

DARLING Pumcups—long noted for unequalled efficiency and life in all kinds of cylinders—are now greatly exceeding their own performance records! The new 100% Nylon Composition, available *only* in Darcova Pumcups, does it!

Nylon Pumcups are made in sizes, types and textures exactly right for your particular equipment—ready *now* to give you unprecedented piston packing performance!

Write for helpful data Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.

Williamsport 15, Pa.

DARCOVA THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

LETTERS to the editor

Teflon Rings

We would appreciate learning of a source of the various stock sizes of Teflon back-up rings as shown on page 491 of your 1956-57 Catalog of Fluid Power Products.

WILLIAM W. PETERSON
Nu Jett Products Corp.
Grand Rapids, Michigan

A list of manufacturers has been sent.

Please See Your Library

Since our January Fluid Power Engineering Index was put in the mail we've been asked for reprints of many articles which have been published in APPLIED HYDRAULICS and the other 200 or more publications which we indexed. We can not supply reprints of material from other publications. Also reprints from many of the early issues of APPLIED HYDRAULICS may not be available. Your best bet is to request your public library to supply you with photostats. Many libraries throughout the country are set up to give this service for a nominal charge.

Pressure Loaded Pump

We've been using your Component Application Sheets to prepare a session on hydraulics for our field people. This statement needs additional information: "Many high pressure designs (of gear pumps) are pressure balanced to relieve hydraulic loads on the shaft bearings and to reduce friction forces against the wear plates." How is this accomplished in a gear pump and who manufactures such pumps.

R. B. EVANS
Fairmont Railway Motors, Inc.
Fairmont, Minn.

The statement refers to pressure loaded designs in which hydraulic pressure is directed against the end faces of the gears. Names of manufacturers of pressure loaded gear pumps have been sent.

Circle 32 on Reader Service Card

ADJUSTABLE FLOW REGULATOR

Designed for Panel Mounting

LOOK TO WATERMAN FOR THE ANSWER TO YOUR FLOW CONTROL REQUIREMENTS

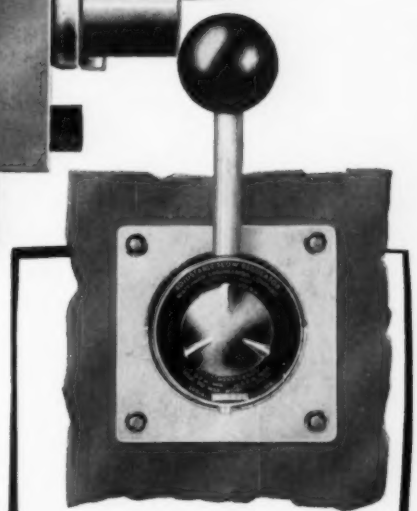
1414 TYPE FLOW REGULATORS have aluminum bodies for light weight and ease of installation. Internal working parts are of hardened and ground steel, selectively fitted to give best possible operating characteristics.
INLET
OUTLET

CUT-AWAY VIEW
SHOWING INTERNAL CONSTRUCTION

Waterman Engineering Company have combined in this new Adjustable Flow Regulator all the best, improved features . . . at the same time adapting it to Panel Mounting.

Increases the flexibility of your hydraulic systems . . . ideal for installations requiring frequent changes in operating speeds.

Affords a variable adjustment of flow rate over a wide operating range.



Write for illustrated bulletin describing the many features of this Adjustable Flow Regulator such as right or left rotation of control handle, 180° handle rotation, pressure drop, regulated flow tolerance, etc.

WATERMAN

ENGINEERING COMPANY

725 CUSTER AVENUE EVANSTON, ILLINOIS

Guarantee TOP Performance and Maximum Life!

Specify THESE TOP QUALITY FEATURES...

(Standard on Miller Cylinders at no extra cost)

Specify CASE HARDENED CHROME PLATED PISTON RODS

On all Air and Hydraulic Cylinders

Benefits To You

CASE-HARDENED Piston Rods (52-54 Rockwell "C") provide practically complete protection against damage from hammer blows, wrench-dropping, mishandling, and similar occurrences. ***Available from Miller at no extra cost.***

The HARD CHROME PLATING over the case-hardened rods protects against scratch-damage and rust. ***Available from Miller at no extra cost.***

Specify "TEFLON" WIPERS

On all Air and Hydraulic Cylinders

Benefits To You

"TEFLON" Rod Wipers and "TEFLON" Hydraulic Piston Rod Seals withstand temperatures from—100°F. to plus 500°F. They are impervious to practically all known chemicals, including the fire-resistant, special, and standard hydraulic fluids in current use. ***Available from Miller at no extra cost.***

Specify TEFLON HYDRAULIC ROD SEALS

On all Hydraulic Cylinders

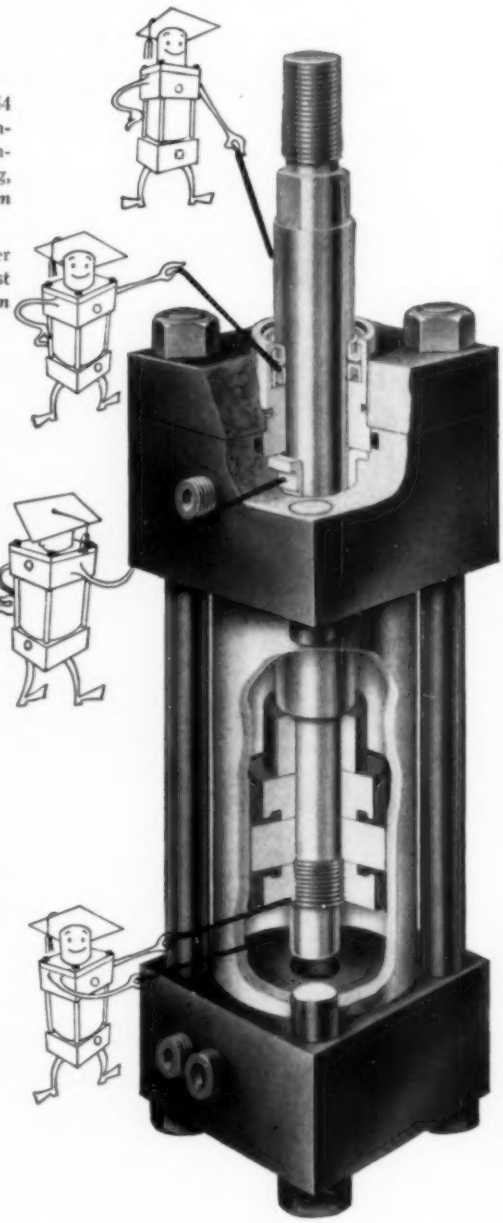
Specify RUST RESISTANT SURFACES

On all Air and Hydraulic Cylinders

Benefits To You

Highest quality Black Ferric Oxide Finish provides rust protection in air cylinder operation and on all cylinders during shipping and installation.

Cylinder heads, caps, mountings, pistons, followers, tie rods, and the unplated portions of the piston rods have this finish ***at no extra cost on all Miller cylinders.*** (This finish not recommended for water service)



You may wish to route this entire page to the proper department in your company, by using this handy form. Additional copies on request. →

To (Dept.) _____

"On all our future cylinder requirements, please specify the above quality features."

Signed _____

Title _____

NOTE. On all Miller Hydraulic Piston Seals: Leather Cup Seals are *standard*, Piston Ring Seals are optional at *no extra cost*, and "Teflon" Cup Seals are available *at extra cost*.

Member of the National Fluid Power Association

SALES AND SERVICE FROM COAST TO COAST

CLEVELAND • YOUNGSTOWN • DAYTON • TOLEDO • CINCINNATI • COLUMBUS
PITTSBURGH • PHILADELPHIA • BOSTON • HARTFORD • NEW YORK CITY
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TORONTO, CANADA and OTHER AREAS

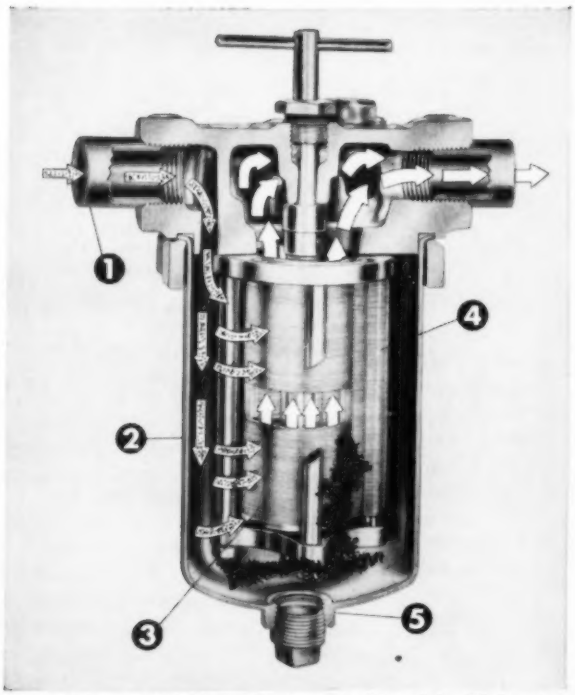
Miller

MILLER FLUID POWER DIVISION FLICK-REEDY CORP.

2008 N. HAWTHORNE AVE., MELROSE PARK, ILL.

AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS

NOW! 40-micron, self-cleaning filter
It's the new Cuno SUPER Auto-Klean



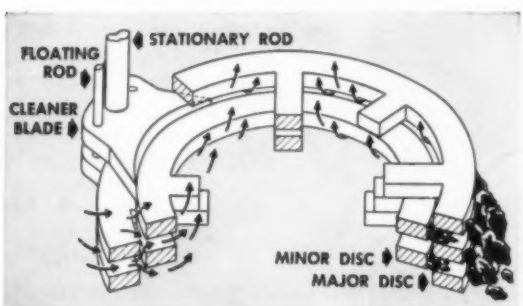
HOW IT WORKS. Dirty oil enters inlet (1) at left, fills housing (2) and flows through metal edge-type filter (3). Clean oil rises through center of filter, leaves at right. Dirt combed out by cleaner blades (4) is removed through drain (5).

Cuno's new SUPER Auto-Klean is the first practical, compact micronic filter for lubricating oil, hydraulic fluid, coolant, fuel, and other industrial fluids.

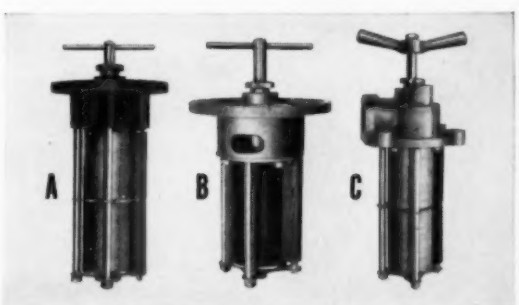
Many times smaller than other micronic filters of equal capacity, Cuno's new SUPER Auto-Klean filter now makes possible economical, micronic filtration at high flow rates and eliminates the need for replacement cartridges in most cases. Here's what it offers:

1. **Full-flow** 40-micron filtration with a self-cleaning filter. Positive protection against particles larger than 40 microns (actually 0.0015 in.). All-metal filter can't rupture or channel.
2. **Easy cleaning.** Just turn the handle—by hand or continuously with motor drive. No interruptions for cleaning.
3. **No cartridge changes.** Ends operating costs if you've been using cartridge filters.
4. **Low pressure drop, no pressure drop build-up.** An 8" by 2¼" SUPER Auto-Klean filters 30 gpm of 200 SSU oil with only 3 psi pressure drop—up to 75% more with slightly higher pressure.
5. **High capacity in a small package.** Many times smaller than replaceable-cartridge type filters of equal capacity, it saves with lower initial costs, lower installation costs.
6. **Easy to build into new equipment.** Available for line-type housings *(left)* or incorporation in sump or reservoir *(below.)* Works in any position.
7. **Easy to install in old equipment.** Fits existing Auto-Klean housings. You can easily replace most 2¼" diameter elements with SUPER Auto-Klean for finer filtration.

Write today for complete technical data on the new SUPER Auto-Klean for your new or existing equipment. Ask for Catalog No. SAK-057. Cuno Engineering Corporation, 2-4 South Vine Street, Meriden, Connecticut. 5.9



FILTER ELEMENT consists of stacked major and minor discs and cleaner blade bearing against minor discs. Small arrows show flow. Short restrictions between minor and major discs stop 40-micron particles but allow high flow rate.



FILTERS FOR INTERNAL PIPING *(A and B above)* allow streamlined design plus the best infiltration. Flange mounting with external outlet *(C above)* and line-type *(large cutaway above left)* are just a few of many other possibilities.

CUNO **ENGINEERED FILTRATION**

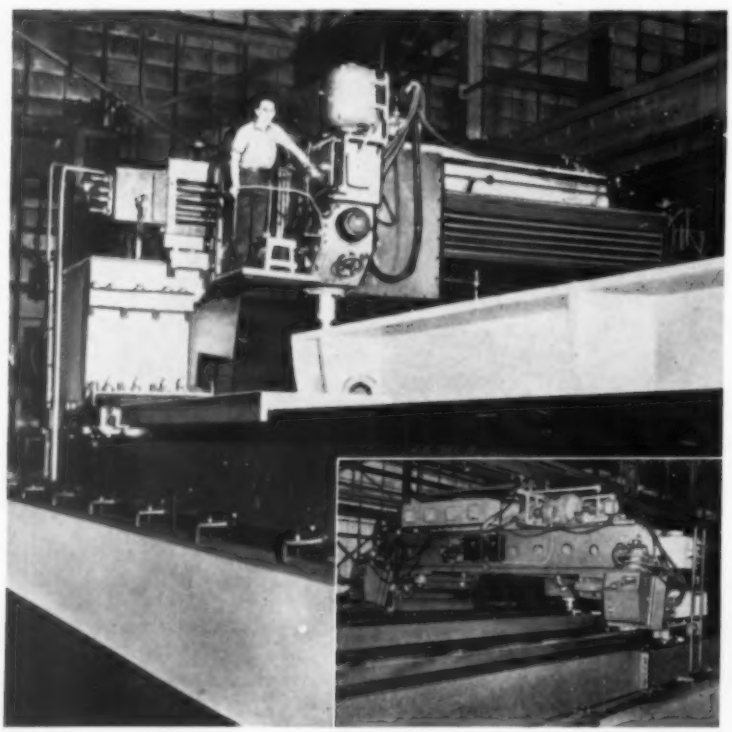
Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (edge-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound) • PORO-KLEAN (porous metal)

BRIEFS about fluid power

HYDRAULIC PRESSURE EQUALIZING SYSTEM ON GANTRY TYPE MILLING MACHINE

To prevent seesawing in the longitudinal travel of the rail along the ways, a hydraulic pressure equalizing system, tracer controlled, has been built into one of the largest milling machines ever built. Designed, built and installed by Portland Machine Tool Works, the machine has a work capacity of 17 feet x 70 feet. The machine, completely hydraulically driven, is equipped with a power package and a 50 hp heavy duty milling head. The equalizing system, wholly embodied in the rail insures accuracy of .002 they parallel throughout the 70 feet length of the ways. Also, the system insures an extremely fine finish, showing relatively few feed marks. Illustrations show view of rail and head, and rear view (insert) with the hydraulic pressure equalizing system on each side. ▼▼▼



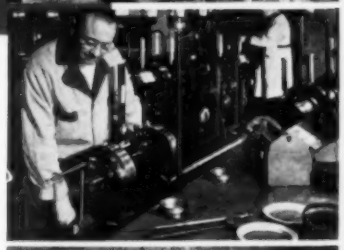
Summer Courses Feature Fluid Power

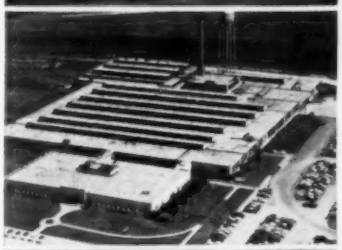
The National Conference on Industrial Hydraulics, sponsored by the Graduate School of Illinois Institute of Technology and Armour Research Foundation of IIT, offers a two week summer course, June 11-22, in "Basic Oil Hydraulic Power". A full time day program, running six hours a day, five days per week, it is designed for shop, maintenance, operating and sales personnel. The course consists of lectures, discussions, laboratory demonstrations and exercises. Among subjects to be covered are properties of hydraulic fluids, pumps, rotary hydraulic motors, piping, seals, valves, basic circuit descriptions and circuits applied to automatic machine operation. The class will be limited to 25 men. Applications, to be considered on a first come first served basis, should be submitted on or before May 15 to: Conference Secretary, National Conference on Industrial Hydraulics, 3300 South Federal Street, Chicago 16, Ill. Tuition for the course is $100.

"Recent Developments in Fluid Power Control" is the subject of a special summer program offered by Massachusetts Institute of Technology, July 9-20. Results of research and development of high performance hydraulic and pneumatic control systems carried out at MIT during the last three years will be presented. Emphasis will be on fundamental aspects of the work with discussion periods for

Continued on page 24

Here's how C/R COOPERATIVE RESEARCH *can help you*





HELP YOU ENGINEER YOUR PRODUCT, ELIMINATE TOUGH TROUBLE SPOTS AND SAVE YOU MONEY IN FLUID SEALING AND RELATED FIELDS

Developing a new product or rectifying trouble in a present one? Why not supplement your own engineering facilities with C/R Cooperative Research? In the areas related to oil seal design, lubricant, chemical, gas, or air retention, and foreign matter exclusion—as well as in the development of synthetic rubber and impregnated mechanical leather parts—Chicago Rawhide's developmental facilities are the most extensive in the country.

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For complete oil reclaiming. Removes solids, acids and volatile impurities; moisture, solvents, gasses, etc., from hydraulic fluids by heat-vacuum process.

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IN CANADA

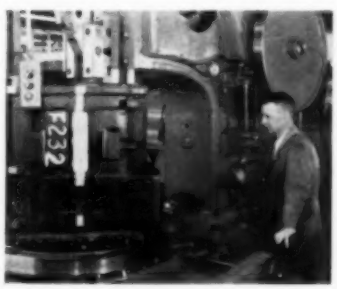
BRIEFS continued

exploring new ideas. Subjects will include control valve configurations and characteristics, pneumatic processes and drives, distributed parameter effects in fluid power lines and fluid power supplies. Application for admission and complete information should be addressed to the Office of Summer Session, Room 7-103, Massachusetts Institute of Technology, Cambridge 39, Mass. ▼▼▼

Slotter Converted To Hydraulics

A cross-feed was changed from a mechanical to a hydraulic drive and a tracer unit to automatically control the drive was installed. This change makes the machine automatic and permits use of an unskilled operator.

Increased production requirements of a motor frame for diesel locomotives led to the need for



an automatic slotting operation. To meet this need, a standard 21 inch production slotter was adapated by Modern Tool Works Ltd. of Toronto.

The rotary table electric drive through suitable gearing was not altered. Mounted on the rotary table are a template which determines tracer action and the work holding fixture. As the table rotates, the tracer valve tip, bearing against the template, controls oil flow to the feed cylinder.

The operator loads the machine, starts the cut, engages the feed and the machine takes over. It shuts off when the job is complete. ▼▼▼

Continued on page 26

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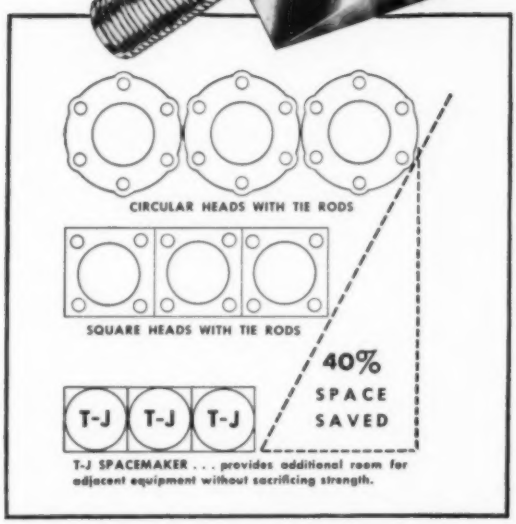
Than Outmoded Tie Rod Cylinders!



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You'll find many answers to *automation* in your plant with T-J Spacemaker Cylinders! Designed with years-ahead features for top performance and dependability. Wide range of styles, capacities . . . for all kinds of push-pull-lift operations . . . reduces man-hours and costs! Write The Tomkins-Johnson Co., Jackson, Mich.

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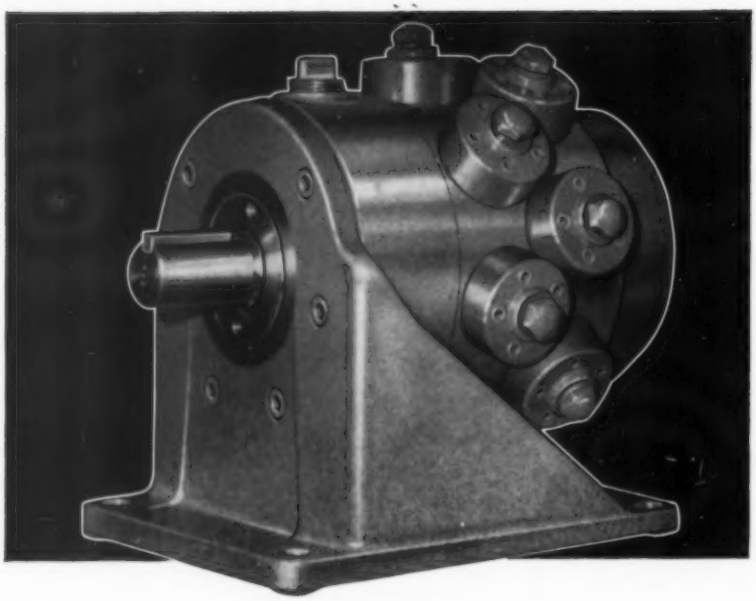
T-J **TOMKINS-JOHNSON**

RIVITORS . AIR AND HYDRAULIC CYLINDERS . CUTTERS . CLINCHORS



for HIGH HORSEPOWER— HIGH PRESSURE service

This Series "C" SECO heavy duty pump is a rugged, revolutionary answer to high pressure, high horsepower requirements. It opens up new horizons in the use of oil hydraulic power.

Pressure is developed *within hollow pistons*—making it possible to generate pressures up to 10,000 PSI without loss of mechanical efficiency. Each piston assembly is completely surrounded by high pressure lubrication and literally *floats* in a hydrostatic film of oil during its pressure stroke. A specially designed oversize Timken bearing assembly insures minimum friction and maximum area of contact at points of piston actuation. *Fluid timed* ball check valves insure quiet and efficient operation at all pressures.

Series "C" SECO pumps are at present made in 2 models, with the following characteristics:

MODEL		C-11	C-5
MAXIMUM PRESSURE, SPOT RATING.....	PSI	5,000	10,000
MAXIMUM PRESSURE, CONTINUOUS RATING	PSI	4,000	6,000
DELIVERY AT MAXIMUM PRESSURE.....	GPM	10	5
SPEED	RPM	1170	1170
POWER INPUT AT MAXIMUM PRESSURE....	H.P.	35	38

If you are interested in high horsepower, high pressure hydraulic power, you should have complete information on these heavy-duty pumps. Use the Reader's Service Card.

SECO

SERIES "C" "HOLLOW PISTON" PUMPS

SIMPLEX ENGINEERING CO.
ZANESVILLE, OHIO

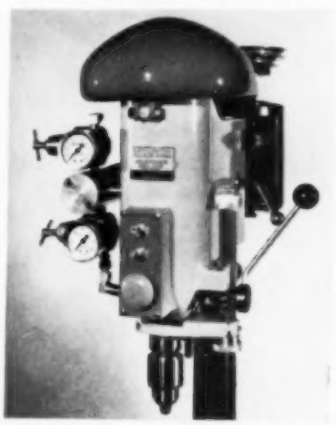
BRIEFS / continued

ASLE Annual Meeting

Twenty-two technical sessions, 43 technical papers and a concurrent lubrication engineers course were presented at the 11th Annual Meeting & Exhibit of the Society of Lubrication Engineers held early this month in Pittsburgh. Papers presented covered Studies in Viscosity, Properties of Lubricants, Application of Lubricants, and Fire-Resistant Fluids Today. ▼▼▼

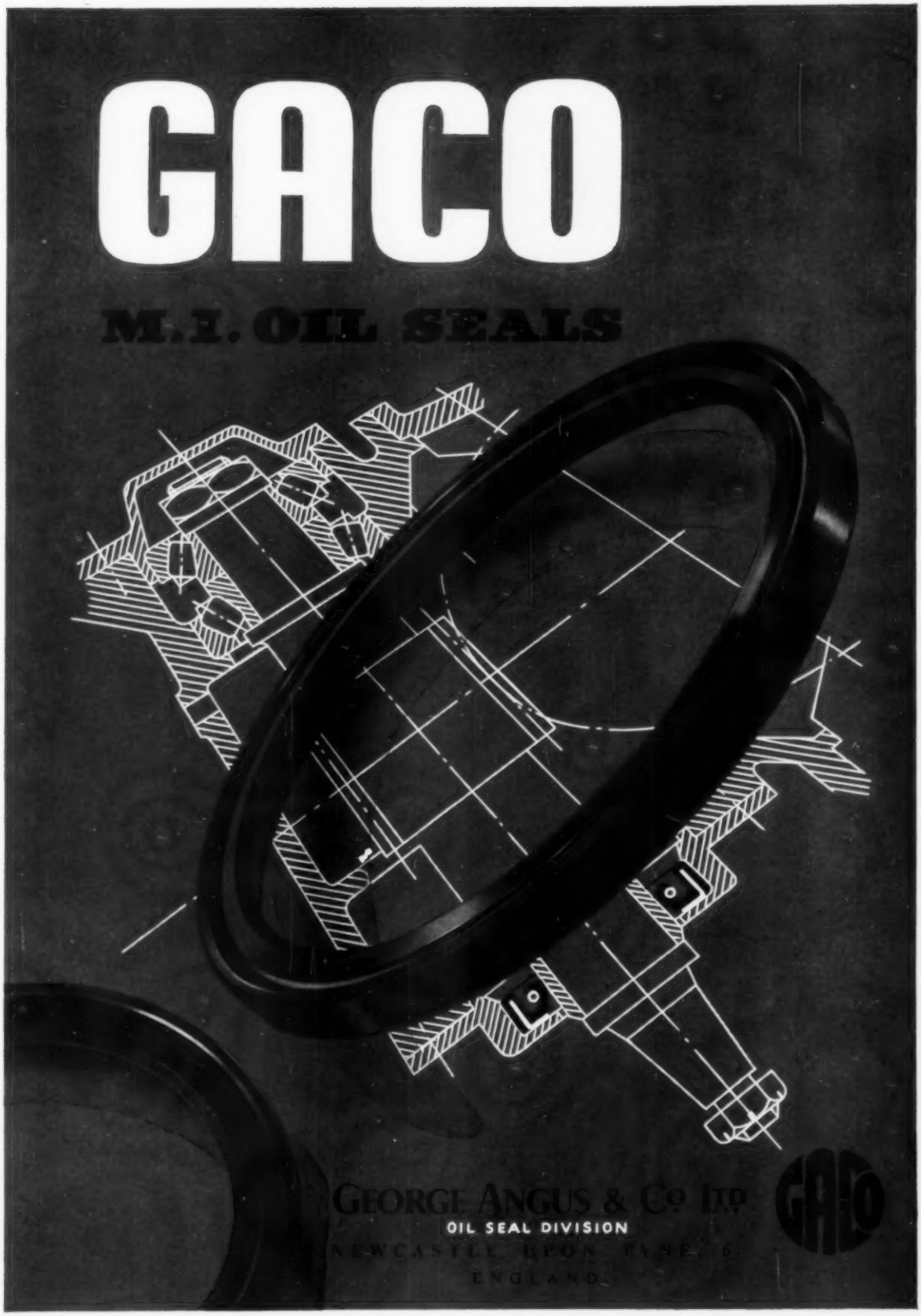
Air-Hydraulic Drill Press Head

This new unit, developed after intensive research and testing, features a choice of completely automatic operation or by shutting off air pressure and inserting the removable drill press handle, manual operation of odd lot drilling can be done. Designed primarily to operate on 30 to 40 psi air pressure for average single spindle drilling operation, a large reserve of gauge pressure is available for use in multiple spindle drilling.



Rotafeed Company built this equipment with a greatly simplified electrical control panel. To its left is the valve assembly consisting of solenoid 4-way spring return valve, two pressure regulators and two gauges. Upper gauge and regulator supplies pressure for downward stroke while lower gauge and regulator permit savings of large volume of air on return stroke by operating at 5 to 7 psi. ▼▼▼

Continued on page 28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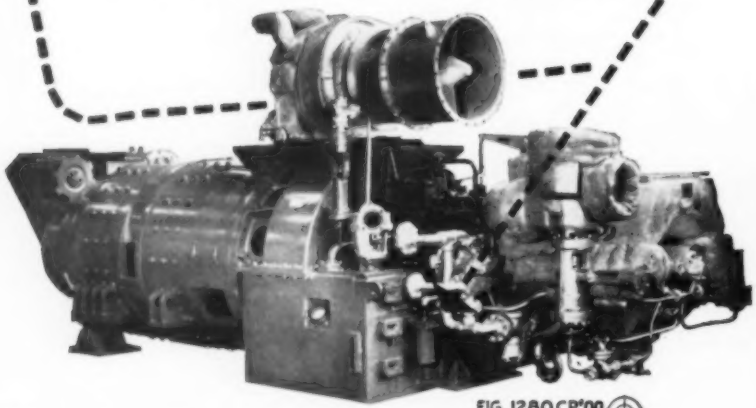
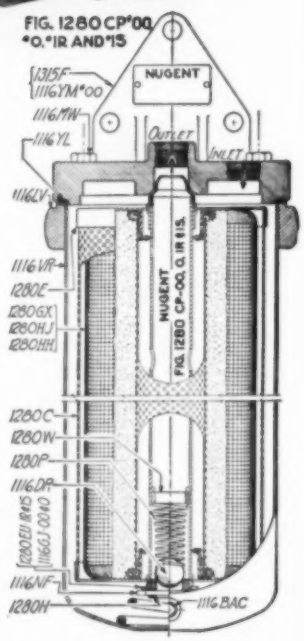
Provide the Positive Protection
Fine Equipment Deserves



The turbogenerator shown above, power plant for the new Norfolk & Western 4500 H.P. experimental locomotive, is assured of maximum protection against mechanical breakdowns due to improper lube oil filtering. Installed on the unit is a Nugent 1280 CP size 1R Absorbent Oil Filter which effectively filters the main gear and pinion lube oil for the generator drive.

Operators of diesel engines, gas engines, turbines and other vital machinery know there is no substitute for safe, low cost, reliable filtering. For this very reason, *Nugent Filters are selected first*—to keep oiling and filtering systems in tip-top shape the year 'round.

Do yourself and your machinery a favor. Check some Nugent equipped installations. Ask the men who know first hand about the value of Nugent filters. Find out how Nugent filters protect your equipment and insure long life . . . how they offer *greater filtering area . . . increase engine dependability* and *do it at lower overall cost!*



For full technical details and specifications, write today outlining your filtering requirements.

Upper right: Sectional view of factory packaged "Throway" Nugent filter recharge.

Lower right: Nugent Fig. 1280CP Pressure Fuel Filter.

Wm. W. Nugent & Co., Inc.
3432 Cleveland St. Skokie, Illinois

Established 1897

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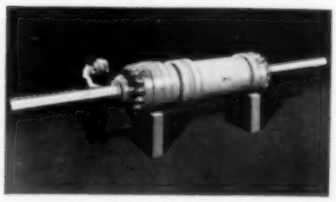
BRIEFS continued

Giant Cylinder For Steel Mill Stripper

To operate tongs on a 400 ton hydraulic steel mill stripper, a special cylinder was required. The Oilgear Company designed and built this 24 inch bore, 84 inch



stroke double-acting 3000 psi hydraulic cylinder. The rams and piston of the unit are one 310 inches long steel forging. Powered by a 35 hp pump, the cylinder has a full load ram speed of 15 ipm and exerts a normal rated force of 446 tons and a peak force of 530 tons in either direction. An auxiliary constant delivery pump rapid traverses the ram at 112 ipm in either direction at any force up to 54 tons. ▼▼▼

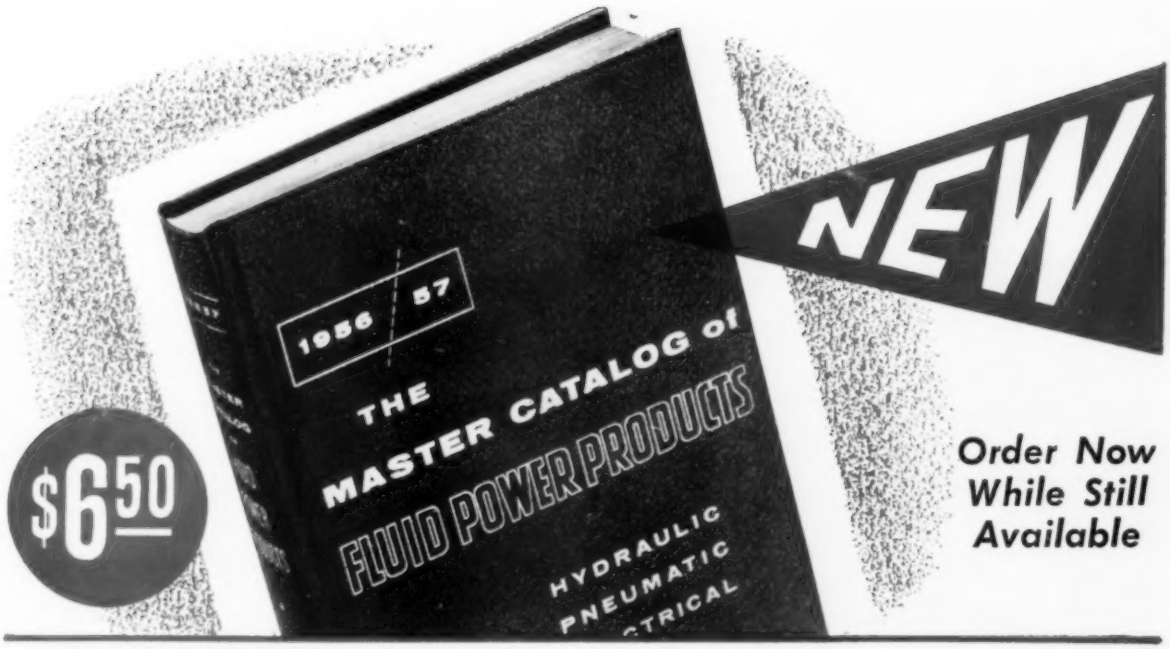
New Type Cold Finished Tubing

The expanded facilities of Tube Reducing Corporation are producing this tubing by a new process, which combines cold compression

rolling and cold drawing. The tubing, which will have improved surface, closer tolerances and superior mechanical properties, is first precision-sized by cold compression rolling in tube reducers, then further reduced by cold drawing to customers' individual specifications.

Illustration shows retort-type furnace used for final annealing of

Continued on page 30



PARTIAL LIST OF CONTENTS OF THE TECHNICAL DATA SECTION

BASIC FLUID POWER DATA
Glossary, Abbreviations, Basic Formulas, Tables and Charts, Nomographs of basic performance and characteristics and Basic Design Problems

MACHINE CIRCUITS
J.I.C. Symbols, Commonly Used Valves, Reservoir Design Rules and Circuits grouped by basic applications—Press Circuits, Processing Equipment, Mobile Equipment, Machine Tool Circuits and Welding Circuits

COMPONENTS AND UNITS
ACCUMULATORS—Types, Applications, Selection, Typical Computations for Cylinder Operation
FLUID POWER BOOSTERS—Types, Advantages, Selections
FLUID POWER CYLINDERS—Applications, Mountings, Construction, Cushions, Force Developed, Air Requirements, Ordering Specifications
ELECTRICAL COMPONENTS—Five Design Steps for Control Systems, Electrical Symbols, Selection of Controls, Electric Motor Characteristics, Uses of Limit Switches
FILTERS—Oil, Air Filters, Representative Circuit Installations, Oil Reclaimers—Purifiers
FITTINGS: PIPE & TUBING—Flared, Flareless Fittings, Couplers, Swivel Joints
FLUID MOTORS—TRANSMISSIONS—Gear, Vane and Piston Motors, Hydraulic Transmissions
HEAT EXCHANGERS—Oil, Air Coolers, Oil Viscosity Chart, Temperature Regulation, Selection
HOSE & HOSE FITTINGS—Oil Hose, Selection and Use, Computing Length of Hose Assemblies, Air Hose, Hose Couplings
HYDRAULIC FLUIDS—Petroleum Base, Properties and Characteristics, Fire Resistant, Aqueous and Non-Aqueous Base
PACKINGS AND SEALS—Types of Mechanical Seals, J.I.C. Recommended Practices (Specifications), Backup and Wiper Rings
PUMPS—Gear Types, Vane, Piston, Reciprocating
TUBING, PIPING, MANIFOLDS—Tables of Size, Tubing Specifications, Recommended Working Pressures, Wall Thickness of Tubing, Types of Panel (Manifold) Construction
VALVES—Functions and J.I.C. Symbols of Pressure, Volume and Direction Valves

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YOU GET THE FACTS WHEN YOU WANT THEM . . .

Here is a treasury of all kinds of hydraulic and pneumatic information that will help every man to save time and avoid trouble in his work. It will go a long way to improve his skill and reputation.

The Master Catalog of Fluid Power Products brings you, in one complete volume, a host of engineering and technical data—formulas, charts, diagrams, circuits and many hundreds of sources of additional data such as manufacturers catalog sheets and "Where to Buy Locally" through engineering sales agencies. You will find in the 618 pages of this indispensable volume, many facts to speed up and simplify your design, engineering and application work.

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BRIEFS continued

stainless tubing. Production capacity will be in excess of several million feet of tubing per month. Size range will be from $\frac{1}{8}$-$1\frac{1}{8}$ inches OD with wall thickness from .005 to .095 inches. ▼▼▼

Hydraulics Reaches Dizzy Heights

A hydraulic platform, truck mounted, for use on construction sites has been manufactured by Simon Hydraulic Machinery, Dudley, England. The unit will lift two workmen to a height of 40 feet. All

movements are controlled by the workmen on the platform, using pedals for raising and lowering and using a knee-operated rotation control. Hydraulic operation is provided by one pump driven by a small motor. This unit will be featured at the British Industries Fair later this month. ▼▼▼

Nuclear Research Assignment For Greer Hydraulics

Westinghouse Electric Corporation, working on a U.S. Navy assignment, awarded a contract to Greer Hydraulics, Inc., for research and development work on a gas pressurizer for atomic power plants.

Basic research and engineering will be conducted on gas pressur-

Continued on page 32

Another Example of

VICKERS HYDRAULICS in Automation

Ex-Cell-O Precision Cylinder Boring Machines shown below are finish-boring V-8 engine blocks. Like so many other high-production machines, these make generous use of hydraulics.

In addition to the advantages inherent in hydraulic control, Vickers Hydraulics gives you the benefits of a nation-wide company-operated field engineering and service organization to assure correct application and operation with least maintenance. Vickers has the complete line of hydraulic equipment necessary to take undivided system responsibility . . . to eliminate any risk of incompatibility of hydraulic components.

The Vickers Application Engineer near you will be glad to demonstrate the many benefits you can obtain by using Vickers Hydraulics. Write for a copy of Catalog 5002B.

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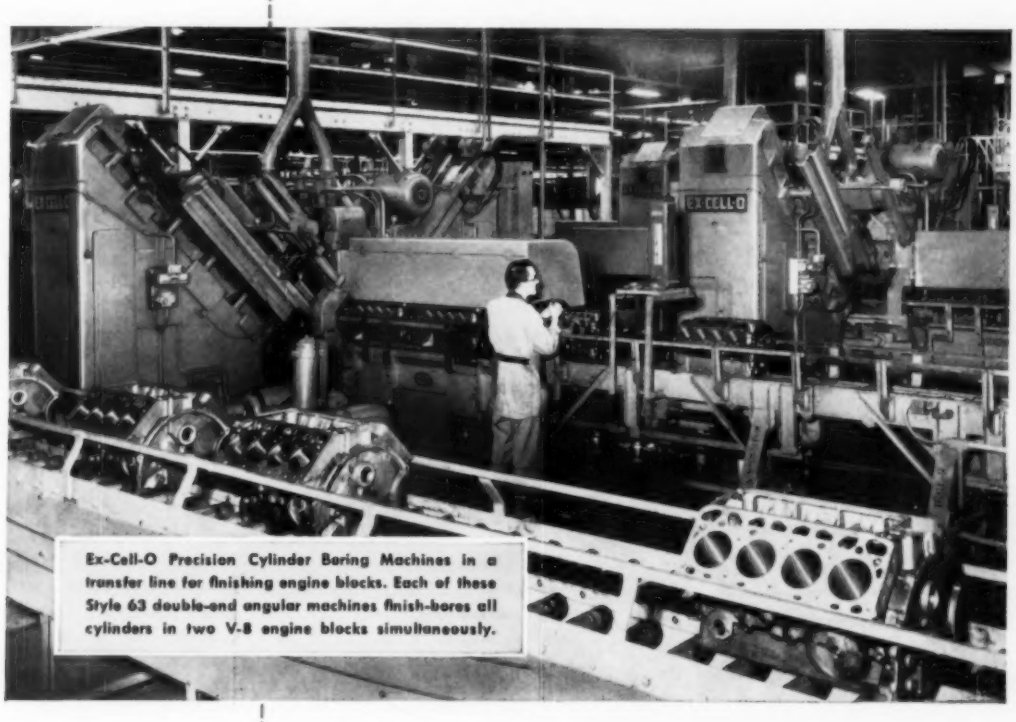
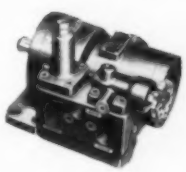
Engineers and Builders of Oil Hydraulic Equipment Since 1921



Ex-Cell-O Precision Cylinder Boring Machines in a transfer line for finishing engine blocks. Each of these Style 63 double-end angular machines finish-bores all cylinders in two V-8 engine blocks simultaneously.

Representative VICKERS Units Used on Ex-Cell-O Precision Cylinder Boring Machines

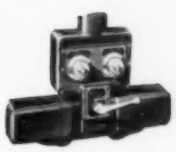


Two-Pressure Pump

Insures lower maintenance cost and saves horsepower and heat in two-pressure hydraulic circuit. Automatically provides high volume at low pressure and low volume at high pressure.

Solenoid Controlled Pilot Operated 4-Way Valve

Compact and versatile "sandwich" construction. Gasket mounting simplifies installation and overhaul . . . also minimizes piping.



Traverse and Feed Cycle Control Panel

Maintains smooth and constant preset feed rate regardless of fluctuations in cutting tool resistance or hydraulic pressure.

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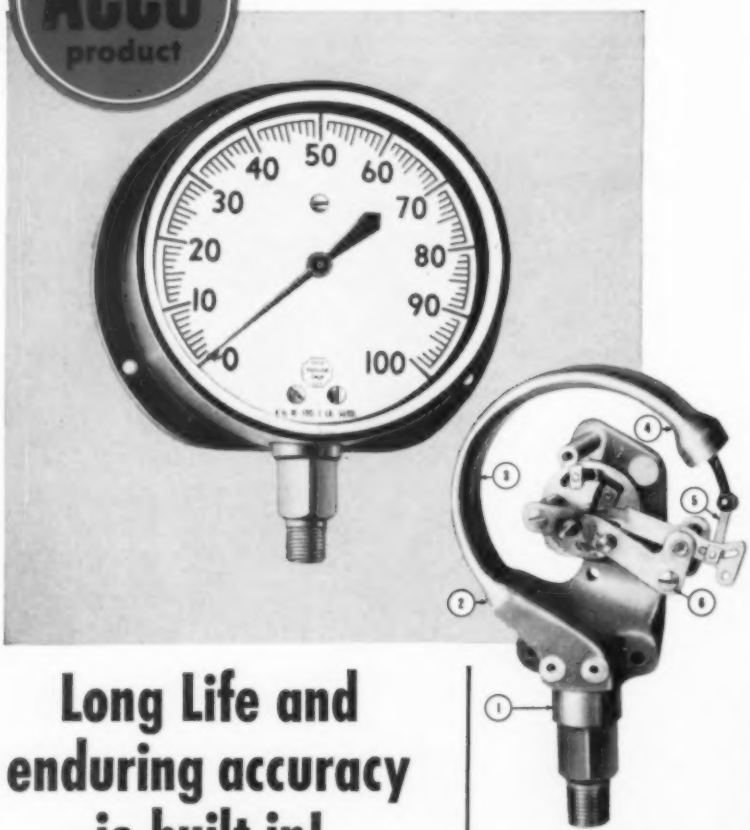
an ACCO product

Helicoid Gages



Long Life and enduring accuracy is built in!

• Sustained accuracy of HELICOID Gages through years of hard service comes from superior design and construction.

The HELICOID Gage has many unique and exclusive features. It is not only a pressure instrument of the utmost precision but one that requires but a minimum of maintenance throughout a long service life.

• The smooth rotation of the spiral movement and cam outlasts and outperforms other gage types. There are no gear teeth to wear out.

HELICOID Gages are available to meet every type of pressure indicating requirement. Ranges are from 15 to 20,000 p.s.i. and vacuum or compound.

Write for catalog today

Why HELICOID Gages last longer!

Socket (1) is one-piece drop forging, streamlined to reduce possibility of clogging.

Bourdon tube* (3) is alloy steel, stainless steel or K Monel.

Tube is welded to forged socket (2) and tip (4).

Connecting link and link screws (5) are K Monel.

Helicoid movement (6) is corrosion resistant.

*Phosphor bronze tube also available.

ACCO

Helicoid Gage Division
AMERICAN CHAIN & CABLE

929-H Connecticut Avenue • Bridgeport 2, Connecticut

for Better Value

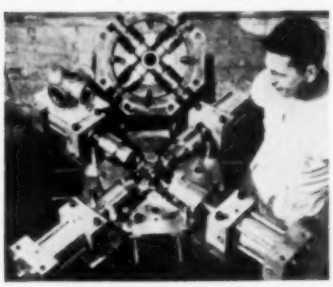
BRIEFS continued

izer apparatus in the primary circuit of an atomic reactor and deal with such factors as: Effects of radiation on the operational life of the bladder-type hydro-pneumatic accumulators, and on the material used in their construction. Possible design modifications of standard accumulators now produced by Greer to adapt them to particular atomic power plant requirements. A team of engineers has been formed to handle this project. ▼▼▼

Hydraulics Speeds New Gasoline Meter Housing Production

Utilizing a combination of three different types of die castings, the Los Angeles Branch of the A. O. Smith Corporation has developed a new gasoline pump meter.

Die cast in aluminum, this accurately-dimensioned, intricately-shaped one piece housing, was de-



signed to incorporate eight moving side cores. Four circular cores are actuated by hydraulic side pulls, the other four comprising the sides of the unit, are moved by angle pulls. Six major openings—one on each of four sides for piston cylinders and one on top and bottom—are all formed by the cores in the die. ▼▼▼

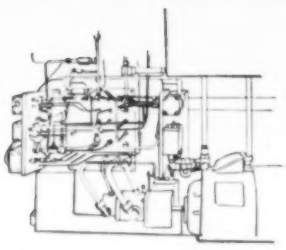
New Industrial Material

Celanese Corporation of America has started commercial production of a new super-strong industrial fiber—Fortisan 36. This fiber, engineered to provide a number of known performance requirements, has properties of great

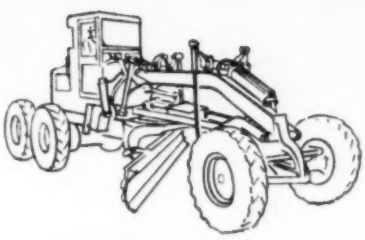
Continued on page 35

Summerill Hydraluster

THE NEW BRIGHT FINISH HYDRAULIC STEEL TUBING



For **HYDRAULIC TUBING**



DIESEL TUBING

Summerill

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TURN PAGE FOR DETAILS ON SUMMERILL HYDRALUSTER

Hot out of the Oven

*Annealing oven, that is

Hydraluster

...The New BRIGHT FINISH Hydraulic Seamless Steel Tubing

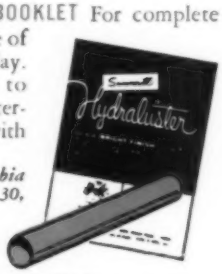
SILVER-BRIGHT FINISH Summerill *Hydraluster* is a *new* steel tubing with a smooth, *bright*, annealed finish . . . a finish that will help you reduce your finishing costs, will give you a cleaner-looking and more attractive product, and will help you or your customer reduce cleaning and maintenance time. *Hydraluster* has the same silver-like finish *inside*, too, to reduce friction to a minimum.

CLEANER This new annealed finish—outside and inside—eliminates oxidation with its resultant flaking inside the tube. Inspection cleaning costs are therefore minimized.

FATIGUE-RESISTANT Not only does *Hydraluster* present an attractive appearance, but it has the strength to better resist effects of vibration and metal fatigue. It can be bent sharply without flattening; withstands flaring without developing cracks. In fact, it exceeds J.I.C. specifications for steel tubing.

FREE SAMPLE AND DESCRIPTIVE BOOKLET For complete details, and for a free testing sample of *Hydraluster*, write or phone us today. We'll welcome the opportunity to *show* how you can make a better-*looking*, better-*lasting* product with Summerill *Hydraluster* tubing.

Summerill Tubing Division, Columbia Steel & Shafting Company, Pittsburgh 30, Pennsylvania.



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HYDRAULIC TUBING • SPECIAL TUBING • MECHANICAL TUBING • DIESEL TUBING • PRESSURE TUBING • AIRCRAFT TUBING

BRIEFS / continued

strength, low elongation and dimensional stability. Its characteristics indicate a bright potential in such fields as high pressure hose, power transmission belting. truck tires, oil hose and other uses in heavy industry. ▼▼▼

Wanted— Hydraulic Engineers

The newly-published 1956 edition of "Engineers' Job Directory" indicates that over 20 percent of the major firms in the United States having active positions available to engineers are seeking hydraulic specialists.

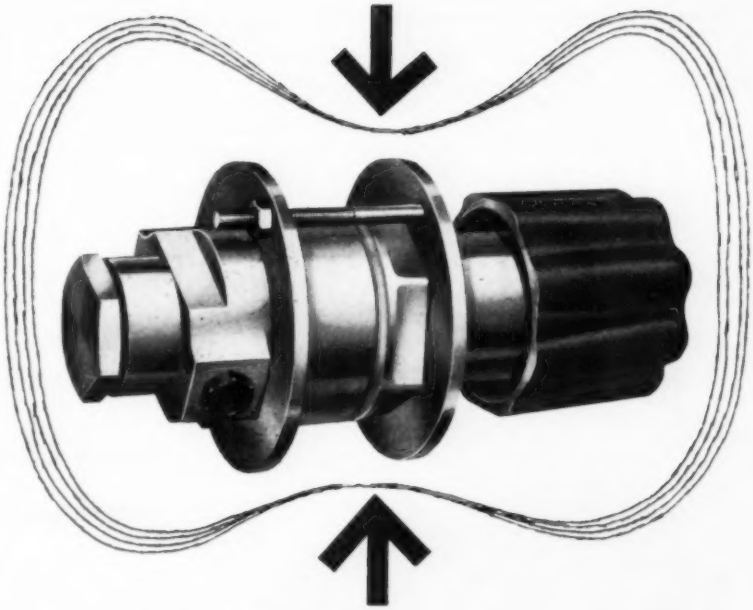
The only authoritative directory of its kind now being published, it has collected its information with the full cooperation of each company listed. Personnel, engineering and research directors outline their company policies, products and locations. The directory can be obtained from Decision, Inc., Cincinnati, Ohio. Price $3.25. ▼▼▼

To Promote . . .

. . . further improvement in hydraulic components and systems through an open exchange of information, Vickers Incorporated is sponsoring the Second Production Machine Tool Hydraulic Forum. Scheduled for May 24-25 at the Engineering Society of Detroit Building, Detroit, Michigan. Attendance at the forum will be by invitation only.

Louis F. Polk, president of the National Machine Tool Builders Association and president of The Sheffield Corp., will be the keynote speaker. Co-moderators for the event will be Hans Ernst, director of research, Cincinnati Milling Machine Co., and Russell L. Dustman, productive equipment manager for Chevrolet Division of G.M.C. One of the highlights will be a special report by Nevin L. Bean, technical assistant to the general manager, Automatic Transmission Division, Ford Motor Co., on his recent visit to in-

Continued on page 38



REVOLUTIONARY, NEW HIGH PRESSURE REGULATOR

Look at these outstanding new developments:

- Widest adjustment range available for manual regulation due to greater sensitivity created by a new engineering innovation!
- ¼" tube straight thread gasket seal bosses per AND10050!
- Maximum inlet pressure of 4500 psi!
- Internal relief valve and filter!
- Internal valve and filter are removable without disturbing spring, diaphragm structure!

Catalog Number	Adjustable Range Outlet Pressure PSI
110100-2	5/150
110100-4	15/300
110100-6	30/750
110100-8	150/1500
110100-10	400/3000

Write today for new engineering data sheet and catalog covering our complete range of regulators.

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HEAT-SOURCE VENTILATION

PLUS values in power

in HOWELL series one hundred motors gives you

GREATER MOTOR DEPENDABILITY

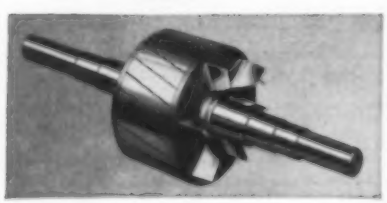
EXTRA INSURANCE AGAINST OVERHEATING

A faster, more efficient way to remove internal heat is a clear plus value for the man who buys motors. The cooler they run, the longer they last — and the more leeway there is to take intermittent overloading or excessively high air temperatures.

The laminations of Howell's new Series 100 Motors have unique, wide slots in their perimeters that carry the flow of fan-driven air right to the source of motor heat. There's 50% more contact between cooling air and the stator laminations than in conventional cores with smooth outer diameters.

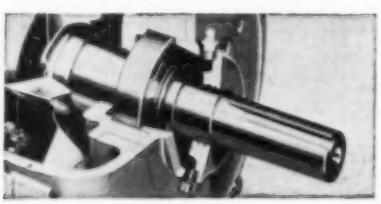
Compare any or all of the new rerated motors with the Howell Series 100. Only then will you have facts to make the best buy!

GET THE PLUS values THAT COUNT....specify HOWELL series 100 motors



heat dissipating copper-clad rotors

Copper's faster heat conductivity (91% greater than aluminum's) reduces heat build-up in Series 100 motors. Copper rotors meet your special design requirements better, too.



Howellube greasing system checks over-lubricating

Grease enters and exits on same side of bearings — is never forced through to pack them tight. Results: longer bearing and motor life.

smaller, lighter, better looking

Save machine and storage space, save shipping weight, and get new functional streamlining that matches the motor to your most modern machine design or production equipment. Why put up with dust catching fins, when a sleek, good looking motor costs no more.

For more details on Series 100 motors, write for Bulletin N-100-R

HOWELL Red Band MOTORS

HOWELL MOTORS

PRECISION-BUILT MOTORS FOR INDUSTRY SINCE 1915

HOWELL ELECTRIC MOTORS COMPANY, HOWELL, MICHIGAN

New Balanced Mobil D.T.E. Oils—

Socony Mobil D.T.E. Oils have long set the standard for performance of hydraulic and circulating oils. Today, after many years of continuing laboratory research and several years of exhaustive field tests, we announce a completely new line of Mobil D.T.E. Oils. These are balanced to give much greater resistance to deposits, longer life even at high temperatures, superior wear protection and rust prevention.

These new oils will meet the over-all requirements of your hydraulic and circulating systems *better than any other product.*

★ ★ ★

For further information on how new D.T.E. Oils can improve your production and cut costs, fill out the form below.

SOCONY MOBIL
CORRECT LUBRICATION

First Step in Cutting Costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates:
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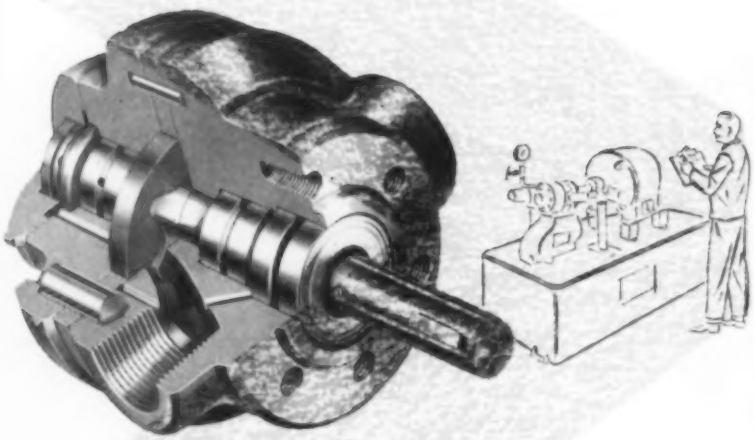
SEND TO: Socony Mobil Oil Company, Inc.
Room 1316, 26 Broadway
New York 4, New York

Gerotor Hydraulic Pumps



give Higher Efficiency at Lower Operating Cost!

All Gerotor hydraulic pumps are recognized throughout industry for their outstanding design and performance. Heart of each unit is the exclusive *Gerotor* mechanism, both elements of which revolve in the same direction at relative low speed. This results in *longer life, less slippage, less wear, a smoother,* more *uniform flow.* In your plant or in your product—a GEROTOR pump means *higher efficiency* at *lower operating cost.*

Due to modern production facilities, GEROTOR can produce special pump designs in *quantities* on an economical basis. Whatever your hydraulic pump problems, bring them to GEROTOR.

Free literature available . . . *write:*

GEROTOR

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MANUFACTURERS OF—

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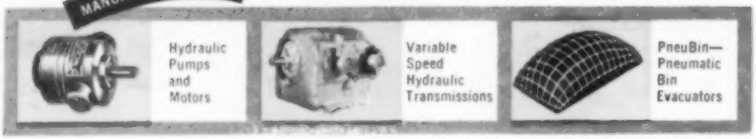


BRIEFS continued

dustrial plants in Soviet Russia. He will give observations on Soviet machine tool industry and its use of hydraulics and automation.

In this year's discussion will be representatives of machine tool builders, users, hydraulic accessory manufacturers and Vickers key personnel. The agenda is prepared from questions submitted in advance by forum participants. ▼▼▼

Recent Publications

Filtration Manual for Product Designers. Published by Purolator Products, Inc. 32 pp. Price 25 cents.

This excellent manual brings under one cover a convenient source of data on filters and filter applications. The text is well illustrated with photographs, charts, tables and diagrams. Some of the chapters deal with such questions as where filters are used, what you gain by planning filtration in advance and what a product designer should know about filtration. A glossary of filtration terms, and quick calculations for sizing up a filtration application are also presented. ▼▼▼

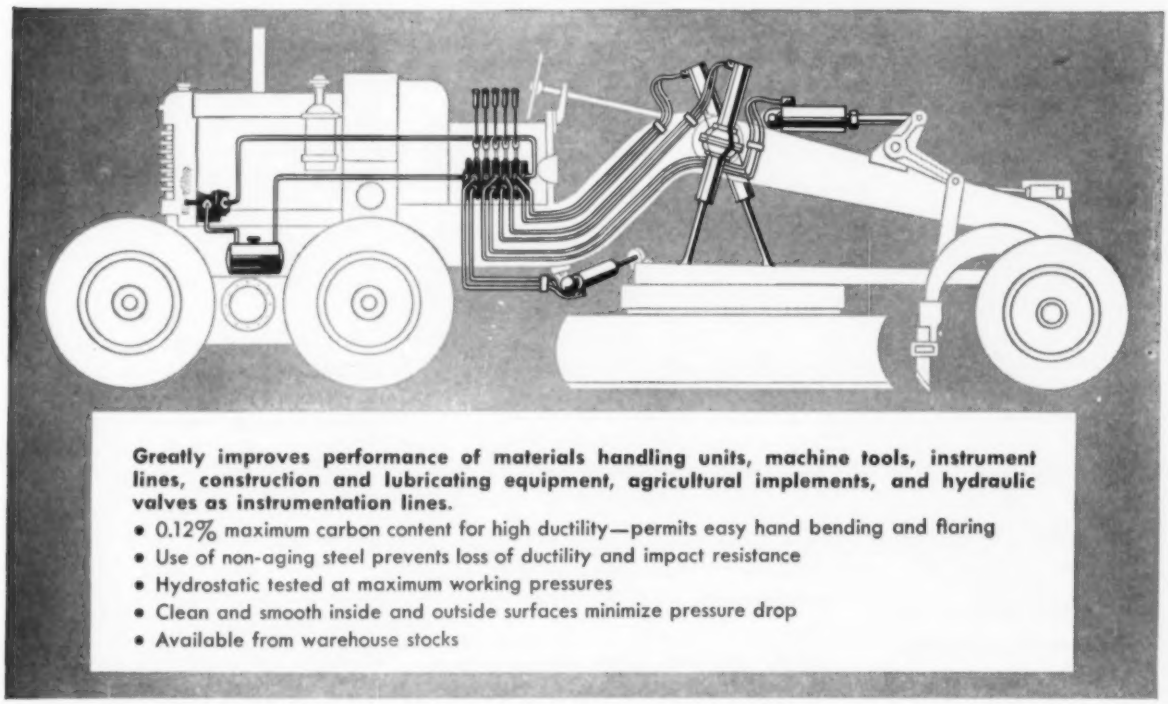
Engineering Standards, Multiple V-Belt Drives, published by The Rubber Manufacturers Association and Multiple V-Belt Drive & Mechanical Power Transmission Association. 24 pp. Price $1.

Engineers will find this completely revised manual of great value in designing V-belt drives. Proper sheaves and belts to be used for optimum efficiency and economy of the drive with relation to the particular duty to be performed are indicated. Increased ratings for standard and premium quality belts are given for belt speeds from 200 to 6000 feet per minute. The basic horsepower formulas for obtaining the new ratings take into consideration drive ratio as well as belt length. Manufacturing tolerances are shown for basic sleeve groove profile dimensions, for standard and deep groove sheaves. ▼▼▼

Continued on page 40

5 BIG REASONS

SUPERIOR SAE HYDRAULIC TUBING PRACTICALLY ELIMINATES TUBING FAILURE



Greatly improves performance of materials handling units, machine tools, instrument lines, construction and lubricating equipment, agricultural implements, and hydraulic valves as instrumentation lines.

- 0.12% maximum carbon content for high ductility—permits easy hand bending and flaring
- Use of non-aging steel prevents loss of ductility and impact resistance
- Hydrostatic tested at maximum working pressures
- Clean and smooth inside and outside surfaces minimize pressure drop
- Available from warehouse stocks

This motor grader is one of the many types of mechanized equipment that use Superior SAE Hydraulic Low Carbon Steel Tubing.

Superior SAE Hydraulic Low Carbon Steel Tubing is made from a carefully controlled non-aging type of steel which will not harden in storage or use. Aging and precipitation hardening are changes in properties that some steels undergo at atmospheric or moderately elevated temperatures after cooling or cold working. These take place even where steel is stored at room temperature, though at a slower rate.

Superior SAE Tubing, whether in storage or operation, will maintain the yield strength, elongation and ductility it has when shipped from the mill.

Superior SAE Hydraulic Tubing is available from distributor warehouse stocks or mill produced to your order in long coils.

Send for a copy of Bulletin 39, containing detailed information on the uses and advantages of Superior SAE Hydraulic Tubing. Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010" to ½" OD—Certain analyses in light walls up to 2½" OD

On the West Coast: Pacific Tube Company, 5710 Smithway St., Los Angeles 22, Calif.

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The "Pressure-Sealing" V-Ring Packing

SEATS AUTOMATICALLY

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KEEPS EQUIPMENT RUNNING SMOOTHLY. CUTS MAINTENANCE

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BASIC MATERIAL COMBINATIONS FOR VARIOUS SERVICES

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A SIZE FOR EVERY ROD & STUFFING BOX

Scientifically designed to make the pressure seal itself, BEL-VEE Rings expand toward the rod and stuffing box wall, on the power stroke or with increased pressure, to automatically form the pressure seal.

On the return stroke, or with pressure relaxed, BEL-VEE Rings contract from the rod for free movement with minimum friction.

BEL-VEE Rings are individually molded in a number of basic material combinations. Offered in sets for pressures to 6000 psi. for sealing reciprocating rods of pumps, engines, compressors, hydraulic equipment and valve stems—handling water, oil, solvents, steam, air and gas.

BEL-VEE Rings are made in practically every rod and stuffing box size. Ask the U.S.G.-Belmont Distributor nearest you or write for Belmont Bulletin No. 4R10.

THE BELMONT PACKING & RUBBER COMPANY
Butler & Sepviva Streets
Philadelphia 37, Pennsylvania

U.S. GASKET • BELMONT PACKING

BRIEFS / continued

Future Events

April 18-19: National Industrial Research Conference, Sherman Hotel, Chicago, Ill.

April 23-May 4: British Industries Fair, Castle Bromwich, Birmingham, England.

April 30-May 4: SAE Aircraft Committee Meetings, Conrad Hilton Hotel, Chicago, Illinois.—April 30-Committee A-3, Aircraft Fittings and Flexible Hose Assemblies; May 1—Subcommittee A-6C, Hydraulic Pumps, Motors & Air Compressors; May 2, 3 & 4—Committee A-6, Aircraft Hydraulic and Pneumatic Equipment.

May 3-4: Sixth Annual Institute of Aeronautic Sciences, West Coast Student Conference, Los Angeles, Calif.

May 9-11: Fourth Welding Show, sponsored by the American Welding Society. Memorial Auditorium, Buffalo, New York. Welding Committee of Atomic Energy Commission will co-sponsor some of the 21 technical sessions.

May 14-17: First Design Engineering Show. Convention Hall, Philadelphia, Pa. Machine Design Division of ASME will sponsor design engineering conference to coincide with exposition.

May 27-31: 1956 Spring Meeting, National Fluid Power Association. The Greenbrier, White Sulphur Springs, West Virginia.

June 5-8: The Material Handling Institute's Exposition of 1956. Public Auditorium, Cleveland, Ohio.

September 17-21: The Instrument Society of America, the 11th Annual Instrument-Automation Conference and Exhibit. New York Coliseum, New York.

October 18-19: 12th National Conference on Industrial Hydraulics. Sherman Hotel, Chicago, Illinois. Conference Secretary is Raymond D. Meade.

October 30-November 1: 1956 Fall Meeting, National Fluid Power Association. Hotel Cleveland, Cleveland, Ohio. ▼▼▼

STRONGER and SAFER for every high pressure pipeline duty...

...because they are drop forged by

Vogt

Send for Catalog F-9

Constantly imitated but never duplicated, Vogt drop forged steel fittings and flanges have unmatched strength and toughness for your most severe pipeline duties. Laboratory controlled materials and Vogt's special forging techniques assure products which are always uniform in structure, fine grained, and free from porosity. Thereby the shocks and stresses imposed by high pressures and high temperatures are easily withstood, and with stubborn resistance to erosion and corrosion. Consult Catalog F-9 for our complete line of fittings and flanges.

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Vogt

DROP FORGED STEEL

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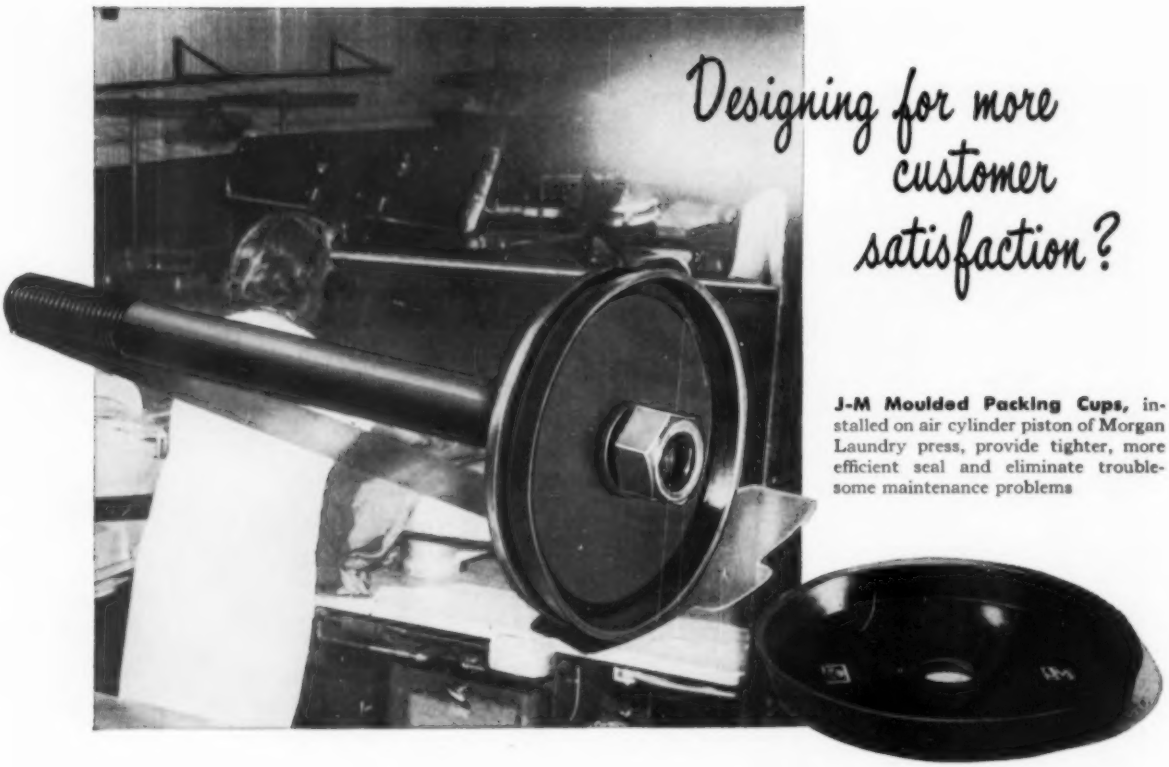


Designing for more customer satisfaction?

J-M Moulded Packing Cups, installed on air cylinder piston of Morgan Laundry press, provide tighter, more efficient seal and eliminate troublesome maintenance problems

When Morgan Laundry changed to J-M Moulded Packing Cups, they found

"Maintenance on packings practically eliminated . . ."

The Morgan Laundry, large supplier to hotels and institutions, encountered excessive down time for maintenance of their laundry presses. Packings supplied as original equipment on the air cylinder pistons of the presses needed frequent lubrication to prevent drying out. It was difficult to maintain proper cleanliness of the equipment.

When the company replaced the conventional material with J-M Moulded Packing Cups, packing life was increased. These packings required practically no maintenance, and the danger of soiling laundry because of relubricating packings was completely eliminated.

Designers and manufacturers can offer their customers many advantages by providing J-M Moulded Packing Cups on original equipment. These custom-made materials may be used on practically all types of air- or hydraulic-operated cylinders. They help improve operating efficiency, and they make possible easier, cleaner maintenance. These factors are especially important in critical installations such as hospitals and hotels, as well as laundries and other service establishments.

J-M Moulded Packing Cups are available in a variety of compositions to meet a wide range of pressures, temperatures and service conditions. For more information on all types of Johns-Manville Moulded Packing Cups, write to Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

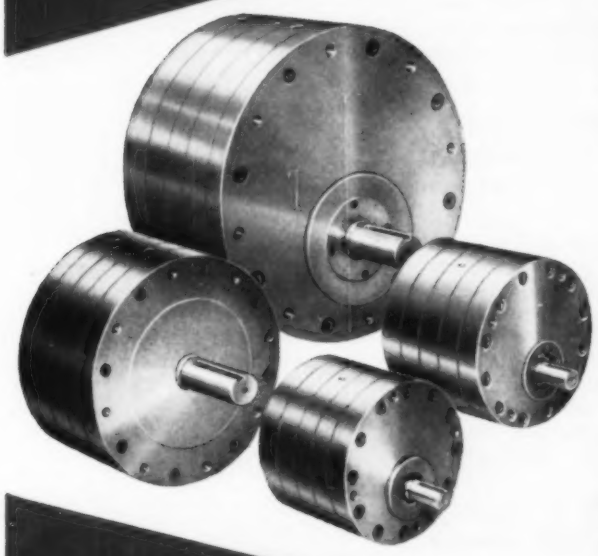
Circle 56 on Reader Service Card

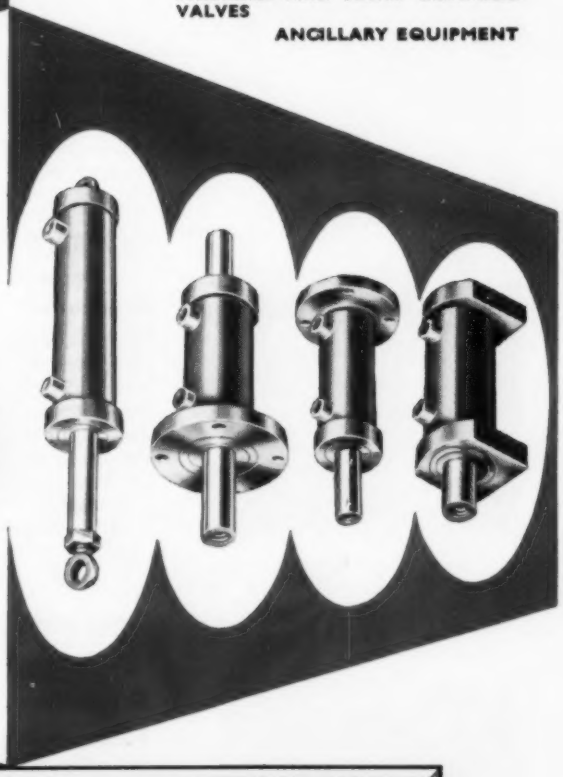
QUALITY . . . in Hydraulic Power Transmission

Our sole business is the design, manufacture and installation of hydraulic power transmissions. With a first-class knowledge of our subject and a fine range of standard equipment we guarantee quality in all our work.

Put us to the test. Send along details of your own hydraulic headache—we'll prescribe a lasting cure!

HYDRAULIC PUMPS AND MOTORS
fractional to 300 h.p. 2000 p.s.i.
DOUBLE-ACTING CYLINDERS
Bores up to 6". Strokes to application
PRESSURE AND FLOW CONTROL VALVES
ANCILLARY EQUIPMENT





INSTALLATION AND PERFORMANCE DATA ON STANDARD UNITS AVAILABLE ON REQUEST

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

Keelavite hydraulics

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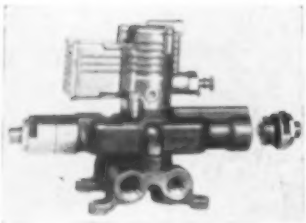
Circle 58 on Reader Service Card

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.



SPEED CONTROL

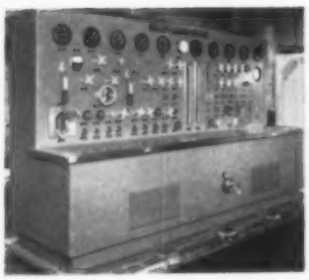
. . . installed in valve

Design: Speed control device mounts in end caps of 3 and 4-way pilot operated valves and restricts spool travel to regulate flow. Threaded stop screws at either end of the valve body can be adjusted to position the valve spool through a complete range of flow control from fully restricted to fully open in both directions. Teflon shock pad in each adjusting screw cushions stem travel, and external lock nuts secure speed adjustment settings. Device is self cleaning and has no needle valves or orifices.

Installation: Speed control may be installed on valves now in service as well as on new valves. Four-way valve kit consists of new valve end caps with adjusting screws and special valve stem. For 3-way valves, standard valve stem is used.

Valvair Corp.
Akron, Ohio

Circle 130 on Reader Service Card



HYDRAULIC TEST STAND

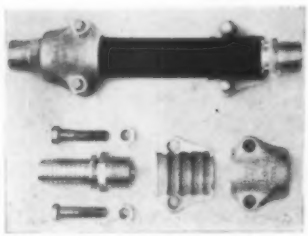
. . . for missile development

Designation: Model 54-720

Specifications: Test stand incorporates all hydraulic pumps, valves, electric motors and controls for complete testing. Unit offers variable flow to 20 gpm with an average working pressure of 3000 psi. A supplemental pumping unit will maintain 5000 psi at low delivery. An accumulator system is provided to maintain any selected pressure from 0 to 5000 psi. An additional independent air-oil booster pump system enables static testing of various components to 10,000 psi. Each pressure system is independently gaged. Stand is equipped to automatically compensate for various type fluids, temperatures, viscosities, pressures, and flows. It permits simulation of various operating conditions.

The Rucker Co.
Oakland, Calif.

Circle 131 on Reader Service Card



HOSE FITTING

. . . for high pressure

Designation: Dynalok

Features: Fitting is made of heavy malleable iron and is secured by two large heat treated bolts. The reusable fitting is error free in assembly and permits quick hose replacement by leaving the fitting on a machine and inserting the new hose over the fitting stem. Triple wire braided hose and clamp are rated for 3000 psi and other constructions are for 2500 and 1500 psi. Clamp fitting is made in eight sizes to accommodate hose from ¼ to 2 inches in diameter.

Application: Fitting is for use on heavy road-building equipment, tractors and farm equipment, oil well equipment, shipyard and dock machinery, and machine tools for general heavy duty plant equipment maintenance.

Flex-O-Tube Div. Meridan Corp.
Inkster, Mich.

Circle 132 on Reader Service Card

For more NEW PRODUCT reviews turn to page 104

MORE AND MORE MANUFACTURERS ARE INSTALLING
MARVEL SYNCLINAL FILTERS
AS STANDARD EQUIPMENT

Manufacturers of hydraulically actuated equipment and others with low pressure liquid circulating systems demand their equipment to perform consistently and with all the productive efficiency they build into the machine that bears their name. Since these systems must be kept free of damaging particles, the selection of a filter is an important factor. Here are some of the outstanding reasons for the increasing preference for Marvel Synclinal Filters to do this all-important job!

SUMP TYPE (Cutaway)

BECAUSE . . . Marvels are designed to give maximum ACTIVE filtering area rather than total filtering area. Only *ACTIVE* FILTERING AREA COUNTS!

BECAUSE . . . Marvels greater storage space for filtered out particles allows longer periods of "production" time at absolute minimum in maintenance cost and "down-time".

BECAUSE . . . Marvels can be disassembled, cleaned and reassembled by any workman in a matter of minutes. Line type operates efficiently in any position and may be serviced without disturbing pipe connections.

BECAUSE . . . Marvels are protected and of sound construction to give long life and efficient filtration.

BECAUSE . . . Marvels (Both Sump and Line Type) are available in capacities from 5 to 100 G.P.M. and choice of mesh sizes ranging from coarse 30 to fine 200, they get a filter to fit their specific requirements.

BECAUSE . . . Marvel not only delivers a top grade filter in both quality and performance, but, as in the past Marvel continues to offer IMMEDIATE DELIVERY.

LINE TYPE (Cutaway)

FACTS— NOT CLAIMS

Engineers decide on the basis of the record, on the basis of measurable facts rather than claims of the "campaign promise" variety. Here is a fact with meaning:

OVER 650 MANUFACTURERS MAKE MARVEL SYNCLINAL FILTERS THEIR O.E.M CHOICE

For Dependable Protection On All Hydraulic And Low Pressure Systems Investigate MARVEL SYNCLINAL FILTERS

Catalogs containing complete data available on request

WATER FILTERS

Both sump and line type filters have been adapted for use in all water filtering applications. No changes have been made in the basic, balanced synclinal design.

FILTERS FOR FIRE-RESISTANT HYDRAULIC FLUIDS

Marvels most recent development is a filter for the efficient filtration of all types of fire-resistant hydraulic fluids.

MARVEL ENGINEERING CO.

7227 N. Hamlin Ave., Chicago 45, Ill. **PHONE: Juniper 8-6023**

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated:

☐ Catalog #107—For Hydraulic Oils, Coolants and Lubricants
☐ Catalog #301—For WATER
☐ Catalog #200—For Fire-Resistant hydraulic fluids.

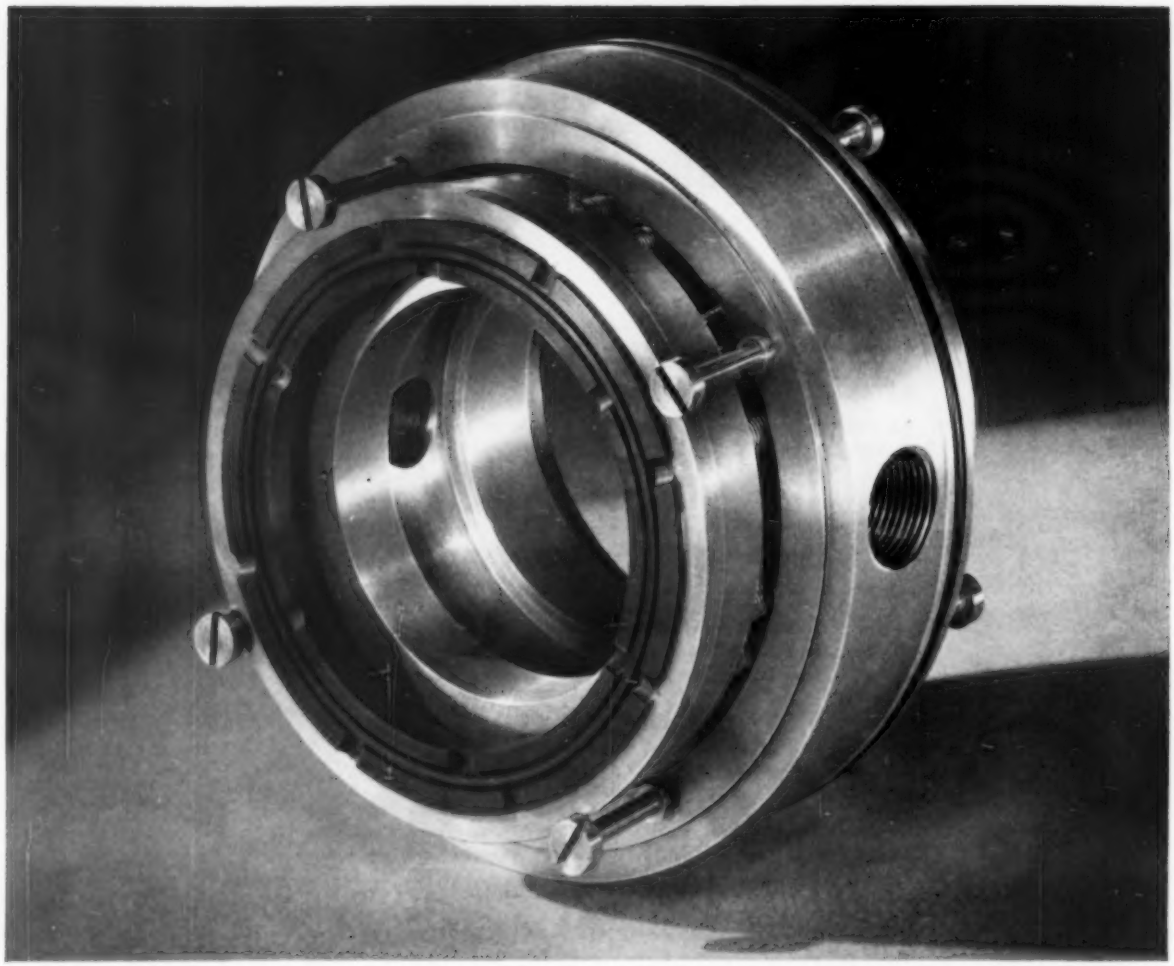
AH-4

Name _____ Title _____

Company _____

Address _____

City _____ State _____



Koppers Face Type Seal Provides Up to 20,000 Hours of Service!

Up to 30,000 Hours in Laboratory Tests Using Clean Gas!

Koppers engineering has created an unmatched sealing surface that gives Koppers Face Type Seals a much longer-than-ordinary service life.

The exclusive design of the sealing surface keeps pressure distribution and hydraulic balance unchanged during operation . . . permits a light face loading which lowers interface temperatures. Hydraulic balance allows sealing of gases and liquids through a wide range of rubbing speeds. Rugged construction adds to Koppers long service life. Rotating collars can be of hardenable stainless steels, cutlery and die steels, Stellites, or of a hard chromium or carbide face. Ring is of carefully selected grades of carbon.

If you have a sealing or piston ring problem, Koppers entire research, production and engineering facilities are at your disposal. For more details, write to the KOPPERS COMPANY, INC., 1504 Hamburg St., Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS®

MECHANICAL SHAFT SEALS

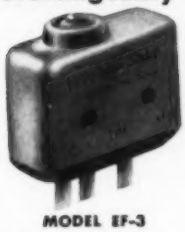
Circle 60 on Reader Service Card

Circle 36 →

NEW SWITCH NEWS

FOR CIRCUIT DESIGNERS

New subminiature sealed switch is environment-free; mounts interchangeably with MS25085

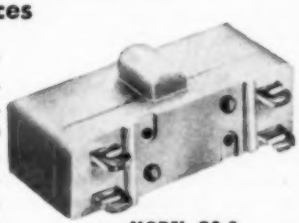


MODEL EF-3

Single Pole, Double Throw
Move. Differential, .004 Max.
Overtravel, .003 Min.
Oper. Force, 5 to 17 oz.
Release Force, 60 gram
Elec. Life Ratings:
150,000 ops. @ 125/250 V. A.C., 2.5 AMP.
100,000 ops. @ 125/250 V. A.C., 5.0 AMP.
50,000 ops. @ 30 V. D.C., (2.5 AMP., IND.; 4.0 AMP., RES.)
Amb. Temp., −65° to +180° F.

Sealed in a corrosion-resistant, treated aluminum enclosure, this tiny switch is environment-free; highly vibration and shock resistant. It carries 5 amps. at 125/250 V.A.C. with an electrical life rating of 100,000 operations. Low operating force and small movement differential make it ideal for bi-metal temperature, diaphragm operated and other "feather-touch" devices, while small size permits mounting singly or ganged in restricted space. Rugged and dependable, it has positive snap action.

Tiny, new 40 amp. basic switch has high capacity, longer life and constant stability of tolerances



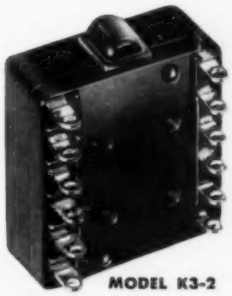
MODEL G3-8

Measuring only 1¾" x 43/64" x 43/64", the new Electro-Snap G3-8 Basic Switch handles current ratings up to 40 amps. A new method of combining Electro-Snap's double-break action with a heavy-duty switching element assures electrical and mechanical life of 100,000 cycles at large capacities; also provides constant stability of tolerances and accurate repeatability. New plastic compound case gives the switch an ambient temperature rating of −65° to +300° F. with extreme shock resistance. Small size makes it ideal for motor controls and compact automation set-ups. A wide range of actuators is available.

OPERATING CHARACTERISTICS

Single Pole, Double Throw
40 AMPS @ 125/250 V. A.C.
@ 30 V. D.C. Res.
Oper. Force, 30 ozs.
Overtravel, .025" Min.
Move. Differ., .055 ± .010

New simultaneous triple-pole switch interrupts 3-phase ac. circuits; 6-circuit control in a small package



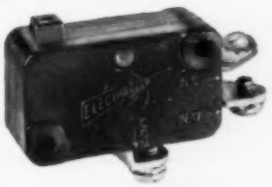
MODEL K3-2

Triple-Pole, Normally open
15 AMP., 125/250 V. A.C.
30 V., D.C. Res.
10 AMP., 30 V., D.C., Ind.
Overtravel, .015 Min.
Move. Diff., .028 ± .007
Mech. Life, 1,000,000 ops.
Elec. Life, 500,000 ops.

This completely new Electro-Snap triple-pole switch simultaneously reverses current flow through three windings of a 3-phase motor up to 1 H.P. and interrupts other types of multi-switching installations. Instantaneous "make" and "break" snap-action of the three poles is independent of the speed of actuation—even extremely slow moving cams can be used.

The K3-2 Series offers designers a wide variety of 3-phase circuit hookups for servo-controls, to limit movement of machine members and as a start-and-stop switch which formerly were possible only with complicated relays or a number of separate switches. A large selection of standard actuators is available.

New small basic switch is low cost; directly interchangeable with AN3234 Specs



F2 SERIES

The new Electro-Snap F2 Series snap action switches are extra-compact with extremely high electrical capacity for their size. Mechanical and electrical life at 1/32" overtravel is 150,000 operations, minimum, with accurate repeatability and constant stability of tolerances. Self-aligning springs provide contact wiping action rare in a switch of this size.

Durable case of special plastic gives the switch an ambient temperature rating of −100° to +275° F. or +375° F. Available, *at low cost*, in three basic models with a wide selection of actuators.

SERIES F2 BASIC SWITCH: F2-3: Single Pole, Double Throw
F2-2: Single Pole, Normally Open; F2-1: Single Pole, Normally Closed

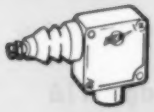
OPERATING CHARACTERISTICS

Electrical Rating: 10 AMP. 125/250 V. A.C. 60 cycles
30 V. D.C. inductive and resistive (6 AMP, 30 V. D.C. for Airborne Application)
Operating Force, 7 to 12 oz.
Reset Force, 4 oz. Min.
Pretravel, 3/64 Max.
Movement Differential, .011 ± .005
Overtravel, 1/32 Min.

SEND COUPON FOR MORE DATA

PRECISION SWITCHES

BASIC SWITCHES



DIECAST ENCLOSED SWITCHES

HERMETICALLY SEALED LIMIT SWITCHES

CONFORM TO MIL & AM SPECIFICATIONS

ELECTRO-SNAP SWITCH & MFG. COMPANY
4224 W. Lake St., Chicago 24, Ill.

Please send data sheets on switches checked:

- ☐ EF-3 — subminiature sealed
- ☐ G3 — 40 Amp. basic
- ☐ K3 — Triple-pole
- ☐ F2 — Extra-small basic

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Useful Literature

For your free copy of publications reviewed, fill in the reader service card

TROUBLE SHOOTING CHART . . . for Hydraulic Systems is offered by Industrial Products Dept. Sun Oil Co. The wall chart gives practical suggestions for such troubles as noisy pump, leakage around pump, overheating, pump not pumping, low pressure, and erratic action. Possible causes are given for each trouble, and detailed correction procedures are presented.

Circle 180 on Reader Service Card

FLUID MOTORS . . . A new bulletin designated DM 321 describes the Dudco MF-100 series vane-type hydraulic motors manufactured by the Kalamazoo Div. of The New York Air Brake Co. The balanced dual-vane fluid motors are the constant displacement type. Their speed varies directly with the quantity of fluid supplied and torque varies directly with the pressure. The motors start, stop, and reverse instantly; and operate at an infinite number of speeds. Cutaway views show how the dual vanes are hydraulically balanced, and the bulletin includes a selection data chart for the four motors in the series. These operate at pressures to 2000 psi and continuous speeds to 2400 rpm. Line drawings illustrate various standard mounting provisions, shaft selections, and port positions and connections.

Circle 181 on Reader Service Card

SOLENOID VALVES . . . for air, oil, and water service are the subject of Bulletin 5-C by Barksdale Valves. 4-way types are shown for 30-150 psi air, water, and light oil. 3-way models are shown for the same applications as well as for 50-500 psi air, oil and water. Both regular and explosion proof types are included. External pilot control, JIC mounting, and auxiliary manual control are features which are available. The bulletin presents specifications and dimensions for each type.

Circle 182 on Reader Service Card

PACKING HANDBOOK . . . A 56-page revision originally published by the National Industrial Leather Association is offered free of charge by J. E. Rhoads & Sons. The revision contains the latest information on packings and their proper application. This booklet has been written and edited by the leading manufacturers of mechanical leather packings, and the data and principles contained in it have been approved by the leather packing industry. Typical subjects are classification of packings, temperature ranges, and advantages of mechanical leather packings. Numerous drawings illustrate proper application of various types of packing, and tables are included to give temperature conversion, capacities of hydraulic rams, and typical examples of JIC packing code identification. Standard dimensions are included for various styles.

Circle 183 on Reader Service Card

HOSE CONNECTOR . . . which seals instantly at both ends and has successfully passed all applicable military fuel and oil tests is presented in a folder offered by Eastern Aircraft Products Corp. The folder has convenient diagrams, performance charts and technical data on the straight-through connector.

Circle 184 on Reader Service Card

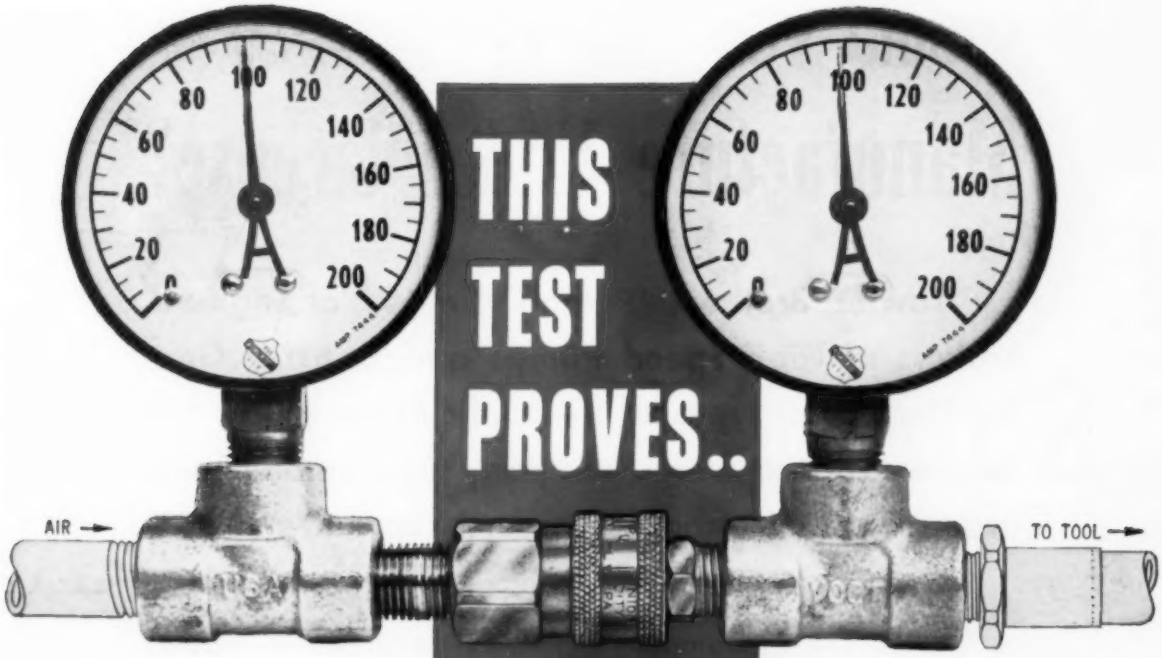
HYDRAULIC FLUIDS . . . are included in 52-page, Form 6500D from Carbide & Carbon Chemicals Co., Div. of Union Carbide & Carbon Co. describing the company's fluids and lubricants. The regular fluids are stable in hydraulic service and their viscosities are unaffected by high rates of shear. They are resistant to the formation of varnish and sludge and to viscosity increases caused by soluble oxidation products. The solvent power of these synthetic fluids for the decomposition products of petroleum oils promotes a cleaning action after changeover. The fire resistant fluids, also described, are balanced formulations of water, ethylene glycol, and a water soluble synthetic fluid. They also contain additives for wear-resistance and corrosion-protection.

Circle 185 on Reader Service Card

APPLICATION IDEAS . . . for product designers has been published by Gast Manufacturing Co. to show how 35 product problems were solved with rotary air motors, air compressors and vacuum pumps produced by the company. This booklet, designated Bulletin 1054, describes features of the vane type construction and lists numerous applications. Selected applications for each product are illustrated and described. Air motor applications including a portable agitator, cement gun, paint heater, and others are shown with the names of companies where these are installed.

Circle 186 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 116



Snap-tite's quick-connect "Hi-Flow" coupling delivers maximum flow with minimum pressure drop

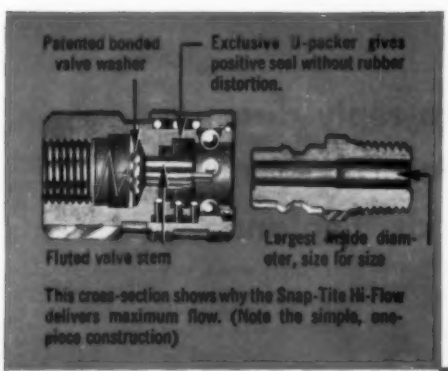
What this test can mean to you

Air tools are designed to operate most efficiently at 90 psi. For every 10 pounds of pressure drop under 90 psi your air tools lose 13% speed and power. If air pressure at your tools is below 90, in spite of a higher reading at your compressor, there are two corrective measures you can take:

One: overwork the compressor to overcome excessive pressure drop of your present couplings . . .

Or Two: install Snap-Tite "Hi-Flow" couplings at each air tool.

Tests run in plants all over America prove "Hi-Flow" couplings lose far less air pressure than any other quick-connect coupling.


Patented bonded valve washer
Exclusive U-packer gives positive seal without rubber distortion.
Fluted valve stem
Largest inside diameter, size for size

This cross-section shows why the Snap-Tite Hi-Flow delivers maximum flow. (Note the simple, one-piece construction)

COMPARE QUICK-CONNECT COUPLINGS

You can set up this quick-connect coupling test in 5 minutes in your plant . . . better still, let your Snap-Tite representative show how really efficient quick-connect couplings increase production and maintenance efficiency in your plant. WRITE

Snap-tite

UNION CITY 1, PENNSYLVANIA

Would You Like To

Manufacture Under License?

Towler Brothers (Patents) Limited, of England, Makers of High Speed Pumps and Control Gear For Use on all types of Hydraulic Press, would like to make contact with a company interested in manufacturing their products under License in the U. S.

- The Towler Company pioneered the direct oil hydraulic system in Europe and is already established in the North American market.

- The pumps manufactured are of the positive displacement type with a 97% volumetric efficiency. Working pressures range from 2,000 to 15,000 p.s.i. and single units up to 600 hydraulic horsepower are built.

- A range of control valves is produced for controlling the main and subsidiary movements of the press rams. Valves may be hand, solenoid or 'Autodraulic' oil servo pressure actuated according to the requirements of the system.

Interested principals are invited to reply direct to:
The Managing Director, Towler Bros. (Patents) Ltd.,
Electraulic Works, Rodley, Leeds, England.

ELECTRAULIC
REGD TRADE MARK
HIGH SPEED PUMPS

DIRECT HYDRAULIC SYSTEM

? ?

6 sizes in 2

of course!

Rivett Model 6655 Solenoid Controlled, Pilot Operated, Panel Mounted, Hydraulic Valve.

Rivett Panel Valves
feature interchangeable sizes

By changing pipe tap size in steel subplate, the 1" basic valve may be used for either ⅜", ½", ¾", or 1" I.P.S.; and the 1½" basic valve for 1¼" and 1½".

CORRECT SIZE IS ALWAYS AVAILABLE

and here's another important feature!

GREATER FLOW CAPACITY

Flow capacities are rated at a higher G.P.M. at less velocity per ft. per sec. For example: the 1" size is rated at 28 G.P.M. at 15 ft. per sec.

The Better You Know Hydraulics—
The Better You Like

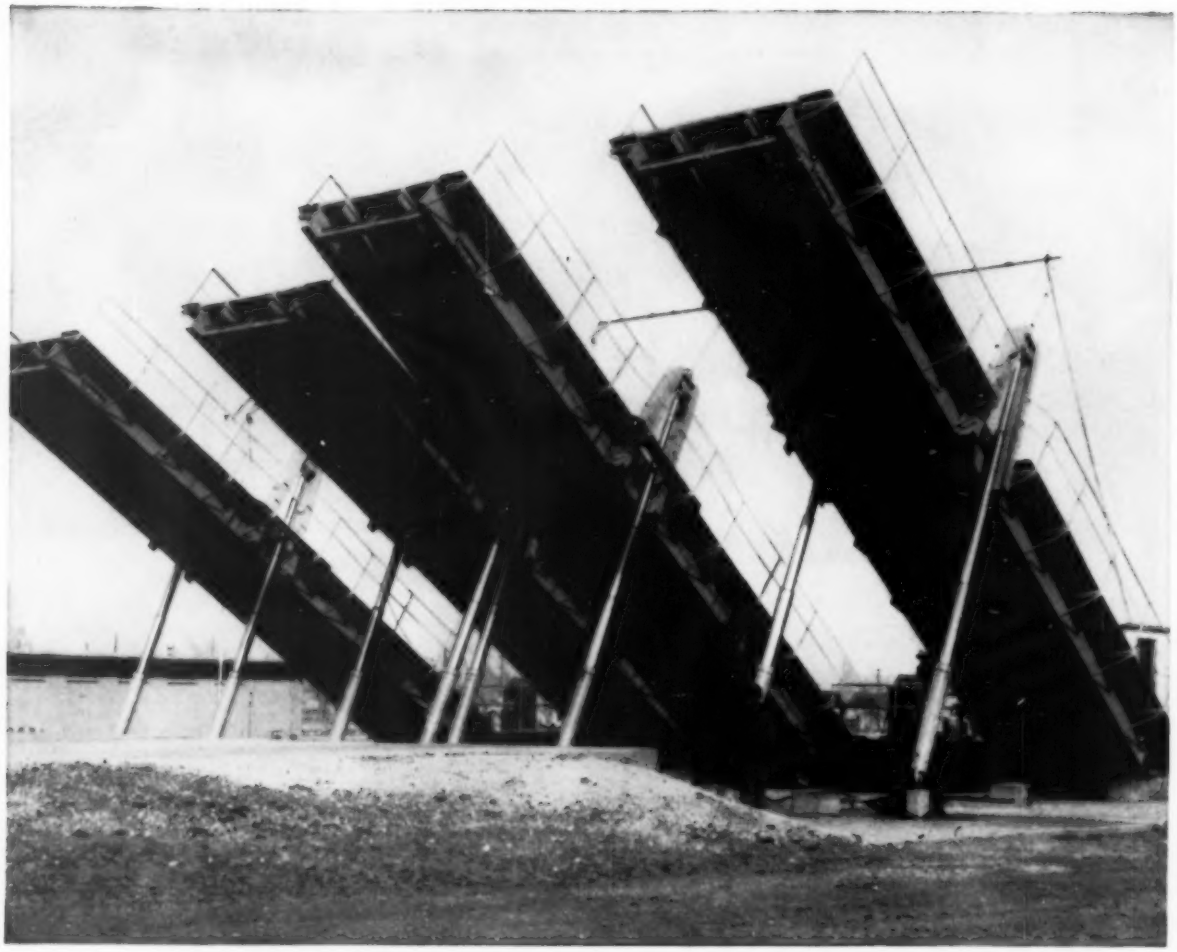
12 other good reasons tell why Rivett Hydraulic Solenoid Panel Valves are your best buy! Get the facts in this new catalog. Write today!

RIVETT LATHE & GRINDER, INC.
Dept. AH-4 Brighton 35, Boston, Mass.

RIVETT furnishes a complete power package

AIR AND HYDRAULIC—VALVES, CYLINDERS, POWER UNITS

Member—National Fluid Power Association



The rams tell the story

THESE ARE cotton seed dumps. Note the bright, shiny hydraulic rams—evidence of how well *Texaco Regal Oil R&O* keeps the system free from sludge and rust. Not visible, but clearly apparent to the operators, is the absence of foam in the hydraulic oil—assurance of smooth, dependable operation.

Texaco Regal Oil R&O has been proved to have *more than ten times the oxidation resistance* of the ordinary turbine-quality oils used in hydraulic service. In addition, it has extraordinary rust-inhibiting power and will not foam. You can count on it to assure clean, trouble-free hydraulic operation, with no unscheduled stoppages.

There is a complete line of *Texaco Regal Oils R&O* to meet the requirements of all types and sizes of hydraulic equipment. A Texaco Lubrication Engineer will gladly help you select the one best suited to your needs.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

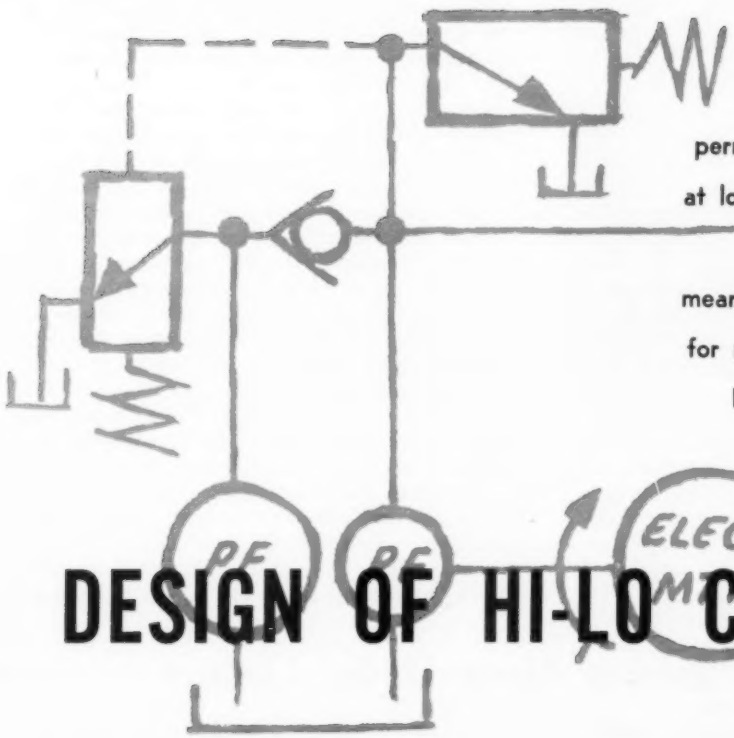
The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO

TEXACO Regal Oils R&O

FOR ALL HYDRAULIC UNITS

TUNE IN: TEXACO STAR THEATER starring JIMMY DURANTE on TV Sat. nights. METROPOLITAN OPERA radio broadcasts Sat. afternoons.



Pump control permitting large volume output at low pressure and low volume at high pressure means greater system efficiency for many oil-powered machines. Here's a discussion of ways to obtain this control.

DESIGN OF HI-LO CIRCUITS

A COMMON machine requirement is rapid movement at small load, followed by slow or zero movement at large load. This is the sequence of most clamping operations, die casting machines, forming presses, and drilling machines. Hydraulics is well suited for this type of job because of the ease in obtaining large pump output at low pressure, followed by small output at high pressure. Several methods are available for this sequence including hi-lo circuits and variable volume, pressure compensated pumps. Which method is best may depend on the pressure and volume required and cost considerations.

BASIC HI-LO CIRCUIT

The hi-lo circuit consists essentially of a large volume pump, small volume pump, unloading valve, relief valve, and check valve. The unloading valve controls delivery of the large volume pump and is operated by pilot pressure at the load. Thus when load increases, the large volume pump is unloaded and the small volume pump supplies the necessary high pressure oil to maintain the machine action. The relief valve limits the pressure of the system and the check valve prevents flow from the small volume pump to the large volume pump when the latter is unloading.

This circuit minimizes power requirements, because only the oil required for maintaining pressure, in clamp circuits, or for slow movement in feed circuits is delivered at high pressure. The major part of pump capacity is returned to tank at frictional resistance only. In addition, to the basic advantage of horsepower savings, the hi-lo circuit may provide many circuit control advantages which are difficult to obtain with

SAVE POWER DOLLARS AND REDUCE HEAT

Power required by a hydraulic pump is:

$$\text{Horsepower} = \frac{\text{Pressure} \times \text{Delivery}}{\text{Constant}}$$

To draw only the power required to do the work, the circuit must be arranged so that pressure varies with load and delivery is only equal to system demand. Any delivery over system demand is wasted. Designs using hi-lo or variable delivery circuits deliver only the amount of oil required. You can waste power because of slippage and leakage. These losses are part of the pump delivery that's not doing any useful work. They can add headaches because of heat. So consideration of pump slippage at maximum operating pressure is important when designing for maximum efficiency.

variable volume pumps. Economically, the hi-lo circuit is often the best for machine tool applications.

In some applications several steps of pressure and volume may be required. For example on a machine for inserting bearings into a large housing, a 30-gpm pump operating at 100 psi is required to bring the bearing applicator to the inserting point. After the bearing is against the bore, a pressure of 300 to 500 psi is necessary to force it into place and this is accomplished with a 5-gpm pump with the 30-gpm pump unloading. After the bearing had been pushed into a portion of the bore at a relatively low speed, a final bore of very close fit requires a very slow push at 2500 psi. The 5-gpm pump is then unloaded and the final pressure is provided by a 1-gpm pump. The return stroke and the initial rapid traverse is supplied by 36 gpm from all three pumps. Many variations of this circuit are used, and the valving may be piped individually, incorporated into a manifold, or designed into a common valve housing.

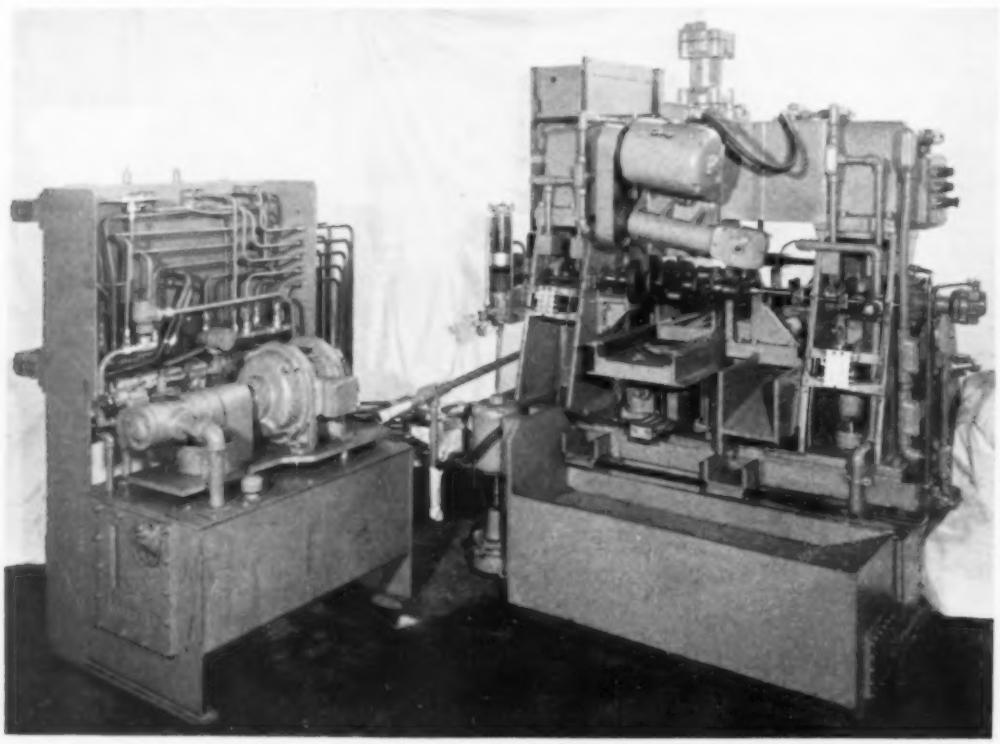
HORSEPOWER REQUIREMENTS

As in other hydraulic installations, horsepower requirements are one of the primary considerations. The volume delivered by the low volume pump should be equal to the maximum flow required during feed (zero in the case of clamps) plus the estimated clearance slip of all valves in the high pressure circuit. Clearance slip is the normal amount of oil that will go through mating metal-to-metal parts in the valves under normal conditions. One rule of thumb for this figure is 25 cu. in. per min. at 1000 psi for a directional control valve. This figure takes into account normal wear based on a ¾-inch valve. This is an arbitrary value and can be increased or decreased according to sizes of valves and pressures.

To reduce costs and stay in the less expensive overall pump casing sizes, there is sometimes a temptation to use the high pressure pump volume in addition to the low pressure pump volume to increase the maximum traverse rate. Thus if 18-gpm rapid traverse oil and 2-gpm feed or holding oil were needed, it might seem logical to use an 11-gpm low pressure pump and an 8-gpm holding

Milling Machine Uses Hi-Lo Circuit

A keyway milling machine designed by Standard Machine & Tool Co., Ltd., Windsor, Ontario has a fully automatic feed cycle consisting of rapid approach, feed, and rapid return. The sequence is

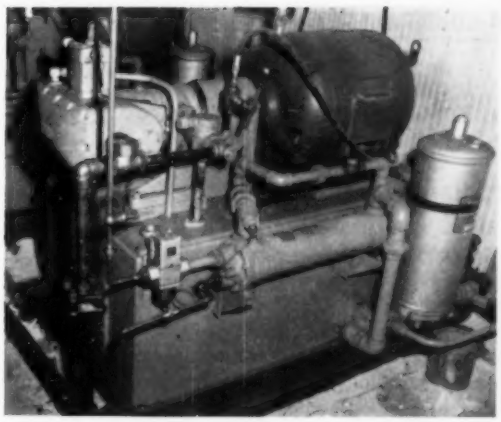


pump and stay in the 11-gpm category. However the heating of the oil and subsequent horsepower loss on the 8-gpm pump would cause trouble throughout the life of the machine. It would be much wiser to pay the greater original cost for an 18 or 20-gpm large volume pump with the correct 2-gpm holding pump even though there would be more low pressure oil available than necessary and a higher initial cost would be involved.

The unloading valve must be of sufficient size to ensure unrestricted flow. Too small a valve is another source for wasted power, and valve sizing should always be on the plus side. Of course there is a power loss involved when the high pressure oil blows off the relief valve. This is unavoidable but can be held to a minimum by keeping the high pressure pump output as small as possible consistent with the machine operation.

Frequently a variable volume pump is used with a large volume, low pressure pump in a hi-lo circuit. This often produces economies by avoiding the necessity of passing oil over a relief valve at the maximum value.

The selection of pumps or a combination unit is dependent upon requirements of the low pressure or high pressure pump, and the driving motor must be controlled by limit switches actuated by the milling heads. Each milling spindle is driven by an individual motor through a V-belt drive. The machine mills two keyways in a crankshaft, turning out 64 pieces per hour.

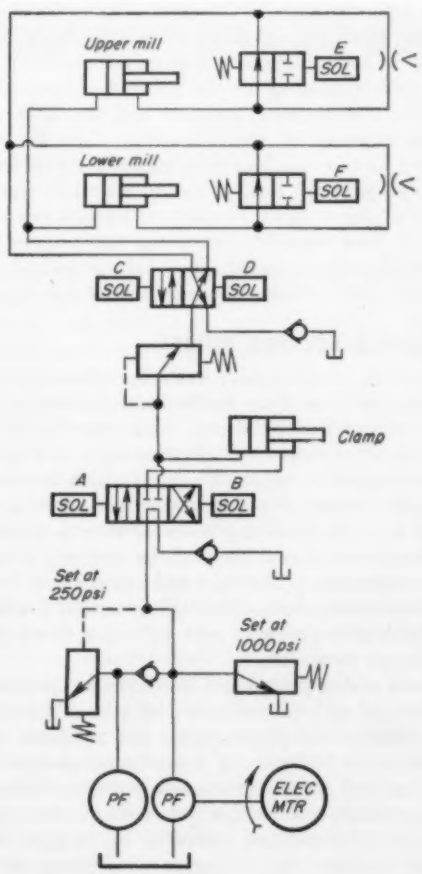


AXIAL PISTON, variable volume pump is controlled by pressure compensator mounted on top of pump. Compensator decreases pump displacement as system pressure increases.

The hydraulic circuit incorporates a combination pump for economic operation during feed. The pump is unloaded during loading and unloading of the machine. Actuating solenoid B extends the clamp cylinder. When the clamp is in place, the sequence valve directs oil through the 4-way valve to extend the upper and lower milling cylinders for rapid approach at 200 inches per minute. The sequence valve maintains 200 psi on the clamp cylinder regardless of pressure variations at the milling cylinders.

At the beginning of feed, solenoids E and F are actuated, so that the flow control valves are placed in a meter-out circuit with the milling head cylinders. The milling cutters feed at a rate of 1 inch per minute for .370 inch. During this feed, the low pressure section of the pump unit unloads 5 gpm to tank. The small volume pump continues to supply 1.1 gpm at the 1000-psi setting of the relief valve.

Deactuation of solenoids E and F and actuation of solenoid C causes the milling heads to retract at a speed of 250 inches per minute. Solenoid A is energized to unclamp the workpiece and is then de-energized to unload the entire pump unit. ▼▼▼



of sufficient size to accommodate the higher of these.

COMBINATION UNITS

Double pumps consist of two pumps constructed as a single unit with separate outlet ports for each pump. These combine a small volume pump with a large volume pump and external valving is installed to make a hi-lo circuit. These double pumps are available with small volume pump capacities from 1.5 to 36.8 gpm and large volume pump capacities from 40.0 to 58.8 gpm.

Combination pumps incorporate a large volume pump, small volume pump, and valving for a hi-lo circuit. These are available for maximum pressures of 1000 and 2000 psi. The 1000-psi units have deliveries of 1.5 to 11.2 gpm for the small volume pump and 3.3 to 36.8 gpm for the large volume pump.

Valve panels which house the valves for a hi-lo circuit are a recent development. These panels are available in two sizes: one based on ¾-inch pipe capacity to 15 gpm and the other based on 1¼-inch pipe capacity to 35 gpm. Connections are flange, threaded, sub-plate or manifolded to the pump. In some cases SAE flanges are provided.

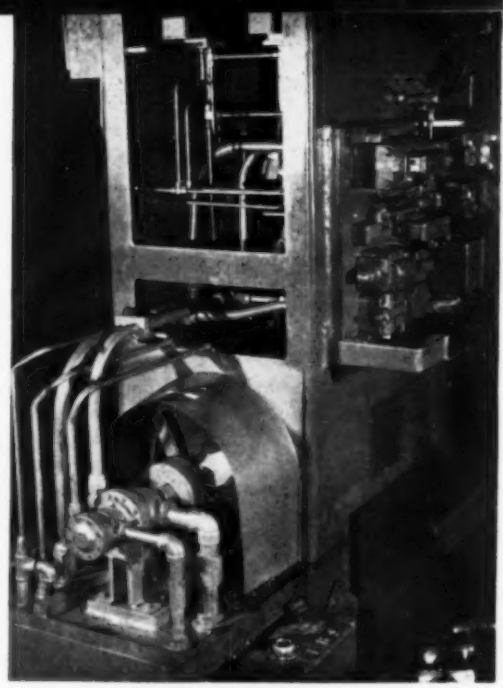
A pilot unloading device permits a close ratio between the cracking pressure and the fully unloaded pressure on the unloading valve. The unloading circuit can be controlled by a signal from the high pressure line, a remote hydraulic signal, or an electrical signal through an integral solenoid control. This solenoid control can also be used on the high pressure relief valve for control of the high pressure circuit with a remote electrical signal.

VARIABLE VOLUME PUMPS

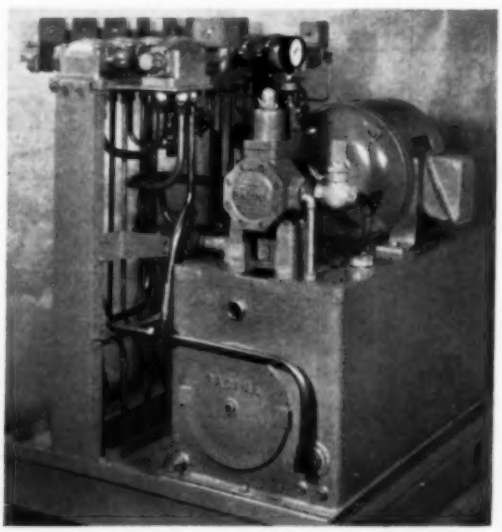
Pressure compensated, variable volume pumps are frequently used for applications involving rapid traverse and feed or clamp. These may be of the vane, axial piston, or radial piston types and incorporate a pressure actuated control which decreases pump displacement as pressure increases. Thus the pump is never delivering more oil than is actually required to maintain the load. In selecting a variable volume pump, the axial and radial piston types may involve higher cost, but this is usually justified by the higher pressures and deliveries obtainable, and longer pump life.

Axial piston pumps are available for pressures to 5000 psi with deliveries to 34.4 gpm at this pressure. Other axial piston pumps are available with capacities to 147 gpm at a maximum pressure of 2500 psi and atmospheric intake pressure. Variable volume vane type pumps are available for pressures to 1000 psi and deliveries to 70 gpm. For certain applications, a 70-gpm vane pump and a 5-gpm vane pump are available as a unit. Each of the two pump sections is equipped with pressure compensating controls to regulate pump output. No relief valves are needed since the controls automatically regulate maximum pressures and provide safe and adequate overpressure protection. When used in a fast traverse, slow feed circuit, or clamp circuit, the large volume pump reaches neutral position when its delivery is no longer needed and the

Concluded on page 72



DOUBLE PUMP consisting of two vane type units is piped in hi-lo circuit through external valves. Small volume is mounted at left.



VANE TYPE, variable volume pump has integral pressure compensation for control of displacement. Pump is designed for 1000-psi operation.

Here's a new application of a hydrostatic transmission on an industrial truck. This drive eliminates the conventional clutch, transmission and friction brake, which means— lower cost—less maintenance. It's a part of the fast growing acceptance of fluid power for driving mobile equipment. Increased reliability coupled with the well known advantage of . . .

MORE POWER IN SMALLER PACKAGE

. . . puts a hydrostatic drive on a lift truck

• By L. D. Huffman and R. W. Bruins

REPLACING clutch, transmission and friction brake of an engine powered lift truck with a simple hydraulic drive means a substantial weight saving and elimination of repair work. Reduction of weight is particularly important on trucks used in multi-story buildings with low floor-load ratings and light elevators.

The driver who picks up a 4000 pound load and backs out with it, shifts without bothering to apply brakes first, and starts off down the aisle, now merely changes direction of oil flow instead of punishing the gears, shafts, clutch linings and other components.

Basic principles of the all-hydraulic drive system, known as the Colsomatic Drive*, are shown in the schemetic circuit. The gasoline engine is coupled directly to a dual fixed displacement gear pump. A three plunger control valve directs oil to the hoist cylinder or to the hydraulic gear type motor, which is connected to the drive wheel through reduction gears and final drive chain. Overall speed reduction between the fluid motor and drive wheel is 18 to 1.

The control valve provides low and high speeds in each direction and has a neutral point to which it is returned manually or, if released, by the spring-loading of the handle. When the driver wants to slow down, he brings the handle toward neutral. When it is at neutral, the oil is locked on both sides of the hydraulic motor. This brakes the drive wheel. No friction brake system is required.

The high pressure, 1000 psi-3 gpm @ 3000 rpm, pump section is used to provide the effect of low gear—to start slowly and to climb up ramps, as well as to lift heavy loads when oil is directed to the lift cylinder. Supplied by the high pressure pump section, the fluid motor developes 110 in-lbs of starting torque. To increase travel speed, the driver pushes his control lever farther over and brings in the oil from the low pressure, 400 psi-8.5 gpm @ 3000 rpm, section of the pump which is used, together with the output of the

This drive has features which are protected under patent laws in the U. S. and foreign countries.

L. D. HUFFMAN, *Director of Engineering*, R. W. BRUINS, *Manager, Handler Division, The Colson Corporation, Elyria, Ohio*

POWER IN A SMALL PACKAGE

high pressure section, to move the truck in high speed.

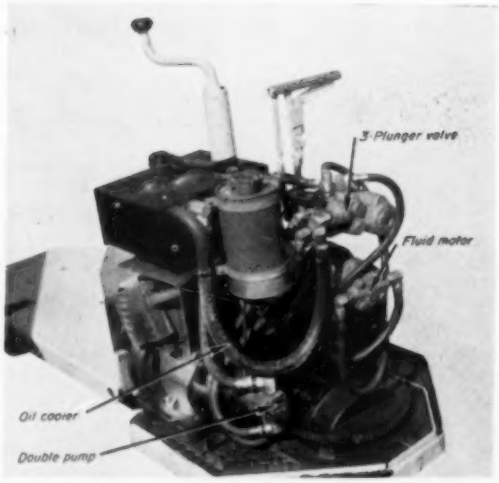
When the driver wants to reverse his direction, he simply pushes his control lever the other way, and the direction of the oil flow to the hydraulic motor is reversed.

Simplicity of this new drive permits the use of "Uni-lever Control"—the operator uses only one lever to control all the functions of the truck except steering. He controls speed range and direction and braking as described. To lift a load he lifts up on the outboard end of the handle and to lower the load, he pushes the handle down. Just below the main bar of the handle is the governor control lever which he squeezes to speed up the engine. The control handle is spring-loaded so that if for any reason the driver lets go of it, the handle returns to vertical. This is "neutral" and stops the truck automatically—a "dead man brake".

In the construction of the small truck, the drive wheel also serves to steer. Here the hydraulic drive system permits stationary mounting of the engine to the frame on shock mounts, and the hydraulic tank and control valve are also mounted stationary to the frame. Flexible hydraulic lines furnish the connection to the rotating drive unit mounted on the turntable. The drive wheel turns in an arc of two hundred degrees for steering.

If a larger unit were built with two drive wheels instead of one, the hydraulic drive system would permit elimination of the customary differential.

There are several safeguards incorporated into the hydrdaulic system. The control valve has an overload safety valve with a by-pass line. A check valve is built into the valve housing, connecting



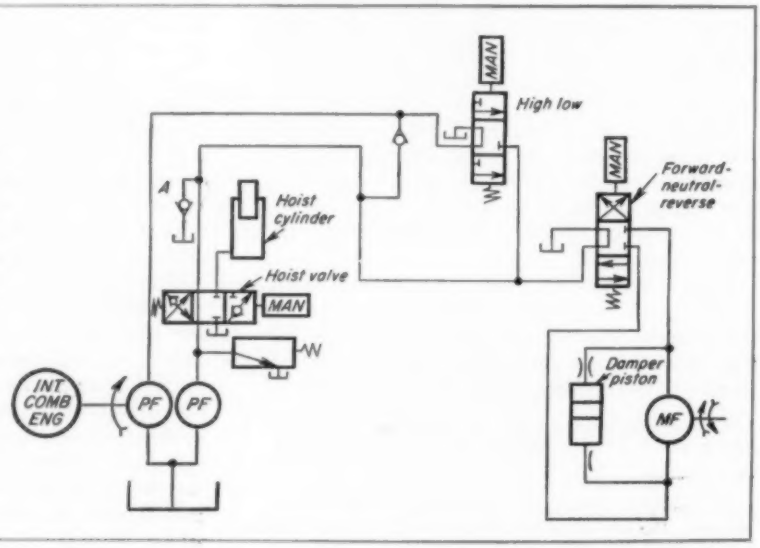
HYDRAULIC power drives this truck through a gear reducer and chain. The same power unit supplies oil to a hoist cylinder.

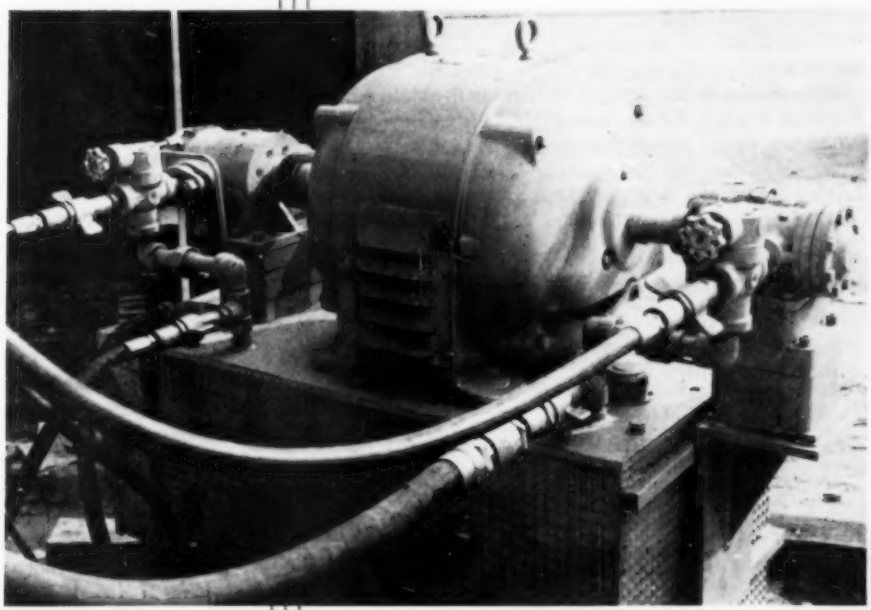
the input side of the valve and the tank to prevent cavitiation of the fluid motor with resultant loss of braking ability when the truck is driving the fluid motor. This can happen when going down a steep ramp or slowing down from high speed with the control lever in forward or reverse position and the engine turning over in low speed. Because of this check valve, positive braking is obtained under all conditions.

A dash pot is built into the valve housing that is connected in parallel with the fluid motor to cushion the starting and stopping of the fluid motor.

Complete accessability for maintenance is provided. The power unit can be removed and replaced in about 10 minutes by two men. ▼▼▼

ALL CONTROL valves are housed in a single three plunger valve. Movement of one handle controls direction of motion, stop and start, and high or low speed of the fluid motor drive.





DOUBLE-SHAFT EXTENSION motor is frequently used for hi-lo pump arrangements and other systems requiring two pumps.

ELECTRIC MOTORS

After the designer of a fluid power system has defined his machine motions and planned his hydraulic or pneumatic circuit, he comes to the selection of a prime mover for the system. In almost every permanent installation, this prime mover is an electric motor. When the electrical distribution system permits, a 3-phase squirrel-cage induction motor is usually used for hydraulic pump applications because this is the most economical and simplest general purpose motor. It is extremely rugged and provides long service with minimum maintenance.

● By Allan E. Morris
Associate Editor APPLIED HYDRAULICS

IN SELECTING a motor for a hydraulic system drive, four general factors must be considered:

a. Power Supply
b. Hydraulic System Requirements
c. Mounting Requirements
d. Ambient Conditions and Enclosures

POWER SUPPLY

The motor must conform to the power system voltage, frequency, and number of phases. Common industrial voltages are 110, 220, 440, and 550 volts. Generally, 60 cycles is the standard frequency, and most industrial installations provide 3-phase power. J.I.C. Standards state that where polyphase (3-phase) power is available, motors ¼-hp and larger shall be polyphase.

The smallest motor which can handle the load should be selected. Induction motors not operating at full load produce a low power factor which in turn gives a higher current than is required for the horsepower output. Since induction motors have a maxi-

mum power factor at full load, it is important not to select motors too big for the job. High speed motors have a higher power factor than lower speed motors of the same power rating. In addition they have a smaller frame size and thus they have lower first cost and are more economical to operate.

HYDRAULIC SYSTEM

Knowing the displacement, speed, and pressure of the pump, the horsepower requirement may be computed with the following formula:

$$Hp = \frac{Q \times P}{396{,}000 \times \text{Pump Efficiency}}$$

Where
Q = Pump output (cu. in.) × Speed (rpm)
P = Pressure (psi)

The power consumption of auxiliary gear drives, power take-offs, etc., must be added to this computed figure.

Where the pump is operated at different pressures for different periods of time, the root-mean-square method of determining horsepower requirements may be used. This method uses the formula:

$$Prms = \sqrt{\frac{T_1 H_1^2 + T_2 H_2^2 + T_3 H_3^2 + \dots}{T_1 + T_2 + T_3 + \dots}}$$

Where T_1, T_2, T_3 . . . are the times of each operation and H_1, H_2, H_3 . . . are the corresponding horsepower requirements.

For an enclosed motor, one-half the idle time is used, and for open motors one-third the idle time is used.

For example, consider a pump with a duty cycle requiring 3, 7, and 2 hp for 3, 10, and 4 minutes, respectively and with an idle period of 12 minutes. The pump requires an open motor.

$$Prms = \sqrt{\frac{3 \times 3^2 + 10 \times 7^2 + 4 \times 2^2 + 12 \times 0^2}{3 + 10 + 4 + (1/3 \times 12)}} = 5.04 \text{ hp}$$

The service factor for motors of 3 hp and larger is 1.15, indicating that the motor can be operated at 1.15 its rated horsepower rating without overheating. Therefore, in the above example, a 5-hp motor would be selected.

In addition to horsepower requirements, the torque requirements of the pump must also be considered. To start and accelerate a load, the motor torque must exceed the load torque. If these two torques become equal, the motor will run at a corresponding speed. If the load torque is nearly the same as the motor torque during a part of the speed range, the motor will accelerate very slowly and may overheat. While running, the maximum torque of the load must not exceed the pull-out torque of the motor or the motor will slow down and stall.

In hydraulic pump applications the motor is started at almost no load since pressure is developed as the pump speed increases. Very often on starting, the pump output is dumped to tank through an unloading valve, so that the motor continues to run at almost no load until the unloading valve is closed at the beginning of the machine cycle.

Three-phase induction motors are classified as type A, B, C, D, and F according to their speed-torque characteristics. Design B is the standard, general purpose type and has low starting current, normal starting torque, and normal slip. This motor has extensive application as a pump drive. When a higher starting torque is required as on some piston pumps and compressors, a Design C motor is used.

The Design B motor has excellent operating characteristics with little speed change for a wide variation of load. The efficiency is high and the initial cost is usually the lowest. However, it should not be used for loads with high inertia.

In addition to the torque requirement, the motor temperature rise must be within the limits of the insulation. For unusual overloads or high temperatures, special insulation is required. Because the cooling air is usually blown by a fan on the motor

TABLE I

Speed Torque Curves—Squirrel-Cage Motors

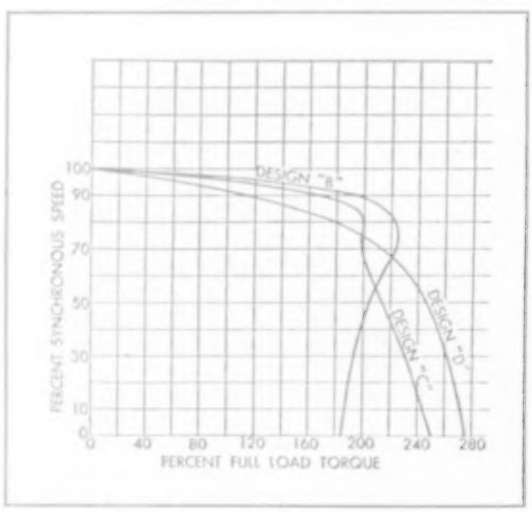


TABLE II. Squirrel Cage Motor Characteristics

Design	Locked Rotor Torque	Break-down Torque	Locked Rotor Current	% Slip
B	Normal	High	Low	Less than 5%
C	High	Normal	Low	Less than 5%
D	High	Low	Low	5% or More

shaft, the heat dissipation of a motor is decreased during starting, stopping and reversing. Thus the duty cycle of the motor must be considered in order to prevent overheating. The designer should attempt to maintain a simple operating cycle and a low inertia load.

On applications involving one or more starts per minute, having high inertia loads, or having limited starting or stopping times, abnormal heating of the motor must be considered. Factors of the motor duty cycle are (1) number of starts, reversals, or stops in a complete cycle; (2) total operating time; (3) time of full-load operation; (4) time of no-load operation; and (5) cycle rate.

MOUNTINGS

Most motors are foot-mounted horizontally. The pump is then driven through a coupling, and in two-pump installations each pump may be driven by one end of a double shaft extension. Pumps may also be mounted on a frame fitted to a Type C face on the motor. This is a flat end bell which is drilled and tapped for the pump mounting, assuring concentricity of the motor and pump. In addition to standard length, keyed shafts; extra long, splined, double tapered, hollow, and other special shafts are available. The standard position of the terminal box is on the left side when facing the shaft. The box may be available on the opposite side for special installations. Vertical motors may be used where required by space limitations or special applications, and they have thrust bearings to support the rotor weight. Motor-pump units in which the pump is mounted directly on the motor are available in a wide range of pump capacities and motor horsepowers.

In mounting a motor, J.I.C. Standards require that the motor be accessible for maintenance. Belts and chains must be easily replaceable. When mounted inside a machine, the cleanliness of the enclosure and availability of cooling air should be assured. Any openings of the motor compartment to the outside or to other parts of the machine should be protected against dirt, chips, etc. Conduit entrances into the compartment should be sealed to prevent entrance of dirt.

ENCLOSURES

The type of enclosure for the motor depends upon the atmospheric conditions in which the motor must operate. The two most common types of enclosures are open and totally-enclosed. Of the totally-enclosed

TABLE III. Locked Rotor Torque—% Full Load

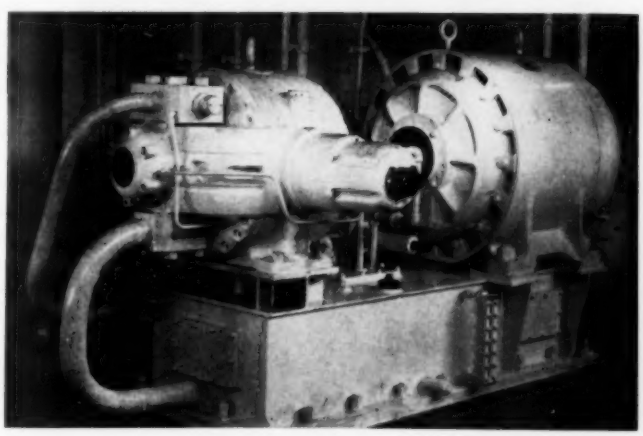
Hp	60 cy. / 50 cy.	DESIGN B								DESIGN C		
		3600 / 3000	1800 / 1500	1200 / 1000	900 / 750	720 / 600	600 / 500	514 / 428	450 / 375	1800 / 1500	1200 / 1000	900 / 750
½		.....	.....	.....	150	150	115	110	105	.....	.....	.....
¾		.....	.....	175	150	150	115	110	105	.....	.....	.....
1		.....	275	175	150	150	115	110	105	.....	.....	.....
1½		175	265	175	150	150	115	110	105	.....	.....	.....
2		175	250	275	150	145	115	110	105	.....	.....	.....
3		175	250	175	150	135	115	110	105	.....	250	225
5		150	185	160	130	130	115	110	105	250	250	225
7½		150	175	150	125	120	115	110	105	250	225	200
10		150	175	150	125	120	115	110	105	250	225	200
15		150	165	140	125	120	115	110	105	225	200	200
20		150	150	135	125	120	115	110	105	200	200	200
25		150	150	135	125	120	115	110	105	200	200	200
30		150	150	135	125	120	115	110	105	200	200	200
40		135	150	135	125	120	115	101	105	200	200	200
50		125	150	136	125	120	115	110	105	200	200	200
60		125	150	135	125	120	115	110	105	200	200	200
75		110	150	135	125	120	115	110	105	200	200	200
100		110	125	125	125	120	115	110	105	200	200	200
125		100	110	125	125	120	115	110	105	200	200	200
150		100	110	125	125	120	115	110	105	200	200	200
200		100	100	125	125	120	115	110	105	200	200	200

TABLE IV. Locked Rotor Current—220 Volts

Rated Hp	Amperes Design B, C & D
1	24
1½	35
2	45
3	60
5	90
7½	120
10	150
15	220
20	290
25	365
30	435
40	580
50	725
60	870
75	1085
100	1450
125	1815
150	2170
200	2900

TABLE V. Full Load Currents

Motor Rating HP	Amperes 110-V	220-V	440-V	550-V
½	5.0	2.5	1.3	1.0
¾	5.4	2.8	1.4	1.1
1	6.6	3.3	1.7	1.3
1½	9.4	4.7	2.4	2.0
2	12.0	6	3.0	2.4
3	.....	9	4.5	4.0
5	.....	15	7.5	6.0
7½	.....	22	11	9.0
10	.....	27	14	11
15	.....	38	19	15
20	.....	52	26	21
25	.....	64	32	26
30	.....	77	39	31
40	.....	101	51	40



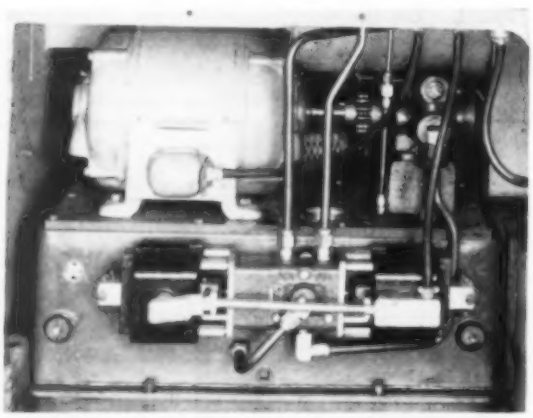
VARIABLE DISPLACEMENT, radial piston pump driven by a totally-enclosed motor.

type, explosion-proof motors are for explosive atmospheres such as fumes and dust.

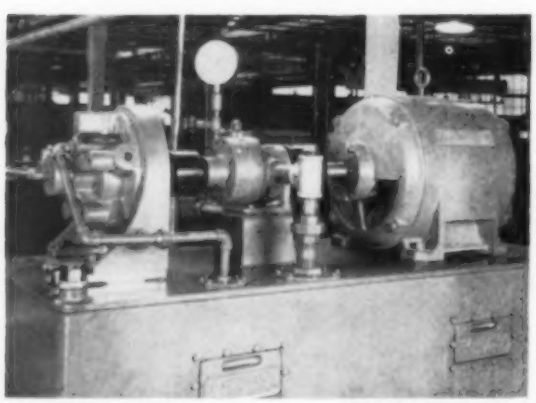
Open motors are constructed to permit a flow of air over the windings. Splashproof and dripproof motors are open motors used in paper mills, textile mills, chemical plants, packing houses, etc. where extreme moisture is present. The motors have enclosures which protect them against the direct action of liquids.

In the totally-enclosed motor, the windings are completely enclosed and the motor is cooled by a flow of air over the shell. In the fan-cooled, totally-enclosed motor, one fan circulates the air inside the motor, and another fan blows outside air over the frame to dissipate the heat conducted through the frame.

The explosion-proof motor has an enclosure which is specially fitted to prevent the escape of sparks which could ignite the atmosphere in which the motor is operating.



COOLING AIR, CLEANLINESS, ACCESSIBILITY must be considered when installing the motor within the machine.



TWO PUMPS are driven from a single shaft extension in this installation.

CLASSIFICATION OF ATMOSPHERES

The National Electrical Code classifies explosive atmosphere as follows:

Class I

Group A — Atmospheres containing acetylene.
Group B — Atmospheres containing hydrogen, or gases or vapors of equivalent hazard such as manufactured gas.
Group C — Atmospheres containing ethyl ether vapor.
Group D — Atmospheres containing gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors, and natural gas.

Class II

Group E — Atmospheres containing metal dust.
Group F — Atmospheres containing carbon black, coal or coke dust.
Group G — Atmospheres containing grain dust.

Class III

Locations containing easily ignitable fibers or flyings, but with only a small amount in suspension in the air.

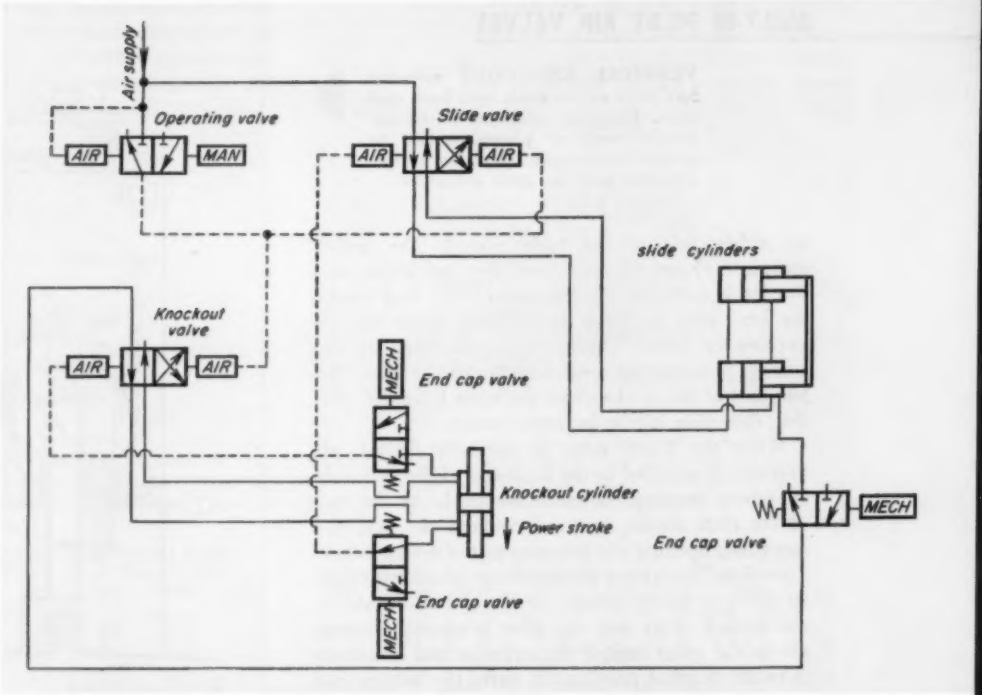
MOTOR MAINTENANCE

Properly selected and installed squirrel-cage motors require comparatively little maintenance, but certain preventive maintenance procedures should be followed. A schedule should be set up so that certain machines can be shut down at definate times and the motor, as well as the associated machine control can be checked. A record of these inspections and the replacement parts should be kept. A reserve of spare parts should be kept on hand and should be clean and in good condition for installation.

New installations of motors should be checked carefully to correct maladjustments before they develope further. Motors should be kept clean. Dust should be wiped off with a dry cloth, and open motors should be inspected for any accumulation of moisture or grease. Grease can be removed with carbon tetrachloride. The rotor of open motors may be cleaned by vacuum or mild air pressure. While the motor is running, the bearing housings should be checked for noises, vibration, or heat.

Depending upon the service of the motor, ball bearings should be cleaned and re-greased periodically. Too much grease can be as detrimental as too little and can cause heating and other bad effects. To grease motors, the relief plugs should be removed, and the motor should be greased while running if possible. The relief hole should be opened with a screw driver or similar tool to remove any hardened grease. Using a hand-operated pressure gun, grease should be added until it begins to flow from the relief hole. This purges the bearing housing of old grease. The motor should then be run long enough to expel all excess grease.

On open motors and some totally-enclosed motors the bearings can be cleaned without disassembling the motor. This can be done while the motor is running by flushing the bearing with a solvent such as light mineral oil heated to 165F, or carbon tetrachloride. ▼▼▼



THREE MECHANICALLY operated pilot valves built into the air cylinder end caps made is possible to simplify the valving for an automatic sepuence of operations. The cycle is fast. Use of hose and quick-connect couplings make the machine easy to disassembly for cleaning.

Built-in mechanically actuated pilot valves add...

SIMPLICITY AND SPEED TO AIR CIRCUIT

AN AIR circuit, in which the ingenious use of end cap pilot valves serves to simplify the valving arrangement and insures proper sequencing of operations, solves problems which confront many industries. The circuit, developed by Republic Manufacturing Company in redesigning a sausage packaging machine, made it possible to achieve major labor savings and greatly increase the production rate.

How can you design a compact multiple cylinder machine with a minimum of external valving and piping so that it fits into the necessarily clean environment of a food packaging plant? The obvious answer is to couple the valves to the cylinders. This solves the problem of appearance and size and at the same time results in maximum operating speed because flow paths are held to a minimum.

How can control be kept simple and reliable enough to require little concern from a girl operator? The answer here is to arrange the circuit with an automatic cycle which is initiated by a simple hand lever or push button operation.

The machine consists of a table with a horizontal slide at the forward end of which is mounted a multiple die to shape the meat and a vertical head on which is mounted the vertical or knockout cylinder and the valve assemblies. An opening at the rear of the head is provided for feeding the meat into the machine. The meat is fed, under air pressure, from a closed vessel through a nozzle to the head end of the machine. The horizontal slide moves forward, as horizontal air cylinders mounted

BUILT-IN PILOT AIR VALVES

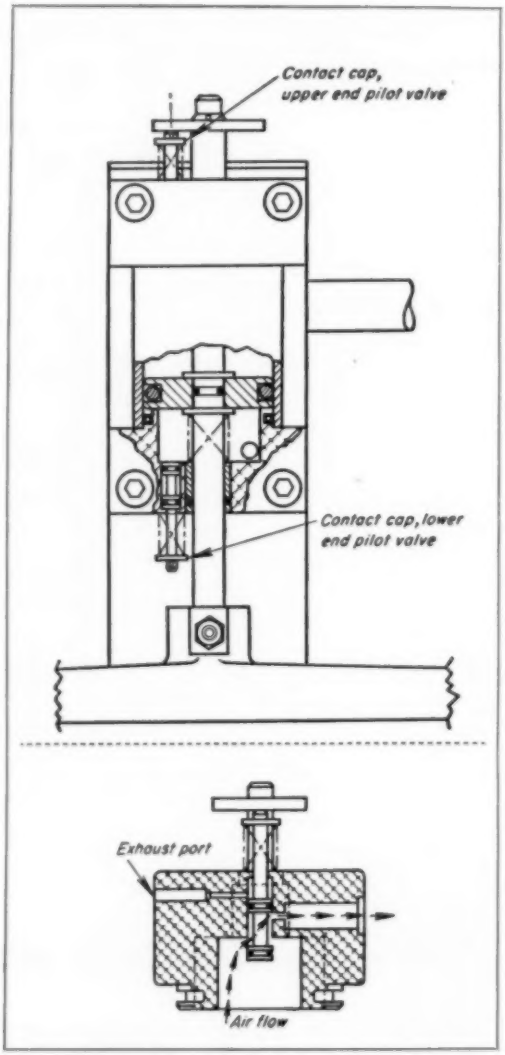
VERTICAL KNOCKOUT cylinder has pilot valves built into both end caps. They are actuated at the extreme ends of piston stroke to properly sequence operation of this cylinder and the slide cylinders

on either side of the table extend. The action scrapes a charge of meat from the feed nozzle and carries it forward. At the end of the feed stroke the head with its die is immediately above the die cavities or form. The vertical cylinder then descends, pressing the meat into the die cavities; the last part of the stroke clears the meat from the cavities, dropping it into an open carton.

When the 3-way valve is manually shifted, air pressure is supplied to the head end of the two slide cylinders, moving the slide forward. At the end of the slide stroke, one rod contacts the first end cap pilot, opening air pressure to the 4-way knockout valve. This moves the knockout cylinder through its down or power stroke. At the end of the stroke the second (top) end cap pilot is opened, routing air to the other end of the cylinder and returning it to its original position. In turn, the bottom end cap pilot, identical with top pilot, opens, admitting air pressure to the rod end of the horizontal cylinders. These return the slide to the rear position, completing the cycle. The entire cycle takes about 2 seconds.

▼▼▼

DETAIL of the upper end cap on the knockout cylinder shows how the pilot valve is made This cylinder has a 1-9/16 inch bore. The pilot valve spool is 3/16 inch diameter.



OPERATOR is initiating a cycle and removing a package simultaneously. At 80 psi the normal operating speed gives a production rate of 1800 eight ounce packages

Photo courtesy Ohio Provision Co.

PUMPS

DEVELOP OIL HYDRAULIC POWER
2 to 100 gpm—continuous duty operation
up to 1500 psi—up to 1800 rpm—single
or double rotation—constant delivery.

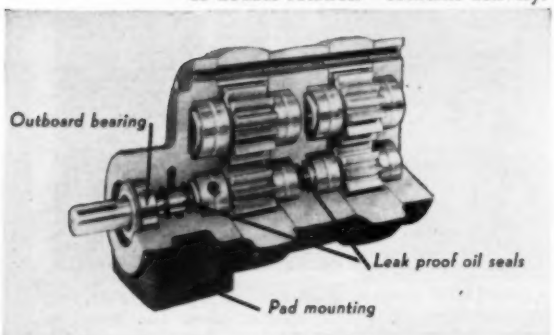


Fig. 1—Two gear pumps assembled in tandem on common shaft deliver independently—can be piped for dual operation or combined for double capacity single operation. "Pressure Pocketing" reduces slippage, friction and wear—volumetric and mechanical efficiency over 90%.

GEAR SIZE	SPEED (R.P.M.)	OUTPUT (G.P.M.) at discharge pressure psi 500	1000	1500	INPUT (H.P.) at discharge pressure psi 500	1000	1500
PC	600	2.3	1.1	0.5	1.2	2.3	3.5
SERIES	1200	4.5	3.6	2.6	2.4	4.5	7.0
1″	1800	7.2	6.0	5.5	3.8	6.7	10.5
PD	600	6.6	6.4	6.3	2.6	4.0	7.0
SERIES	1200	13.2	13.0	13.0	5.2	8.0	13.5
1″	1800	19.3	19.0	19.0	7.5	12.0	20.5
PJ	600	19.4	18.7	18.4	6.2	12.3	18.0
SERIES	1200	41.3	40.6	40.0	12.8	24.7	37.4
2″	1800	62.1	61.0	60.3	20.5	38.6	58.8

Performance data for PC and PD pumps having gear widths other than shown above can be approximated by multiplying values in above table by width of desired gear; for PJ pumps multiply by 1/2 the width of desired gear.

PC SINGLE PUMPS

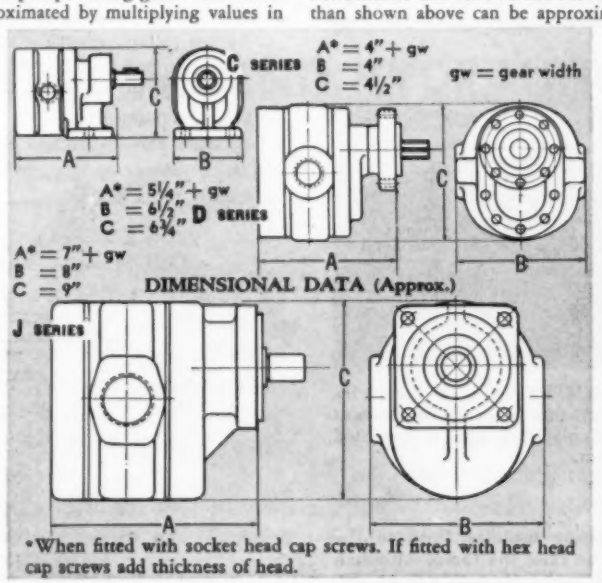
3 gear widths, 1/2″, 1″, 1-1/2″.
4 round shaft sizes.
pedestal and 3 flange mountings.
tapped ports—side or end.

PD SINGLE PUMPS

7 gear widths, 1/2″, 3/4″, 1″, 1-1/2″, 2″, 2-1/2″, 3″
8 round and 3 splined shaft sizes.
pad and 7 flange mountings.
tapped ports—side or end.

PJ SINGLE PUMPS

5 gear widths, 2″, 2-1/2″, 3″, 3-1/2″ and 4″.
1 round and 1 splined shaft size.
2 flange mountings.
tapped or split flange side portings.



*When fitted with socket head cap screws. If fitted with hex head cap screws add thickness of head.

MOTORS

UTILIZE OIL HYDRAULIC POWER
2 to 68 hp—continuous duty operation
up to 1500 psi—up to 1500 rpm—single
or double rotation—variable speed.

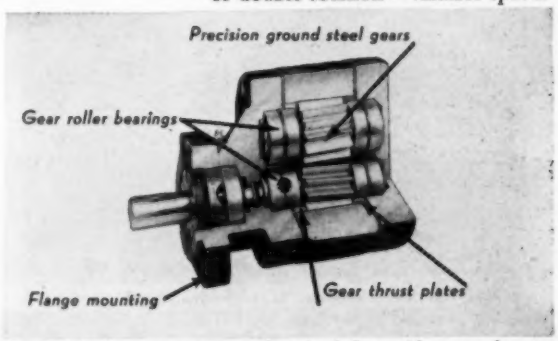


Fig. 2—Single gear motor can be piped from side on end ports. Extra large gear bearings maintain shaft alignment; heavy-duty outboard bearing absorbs drive shaft and shock loadings. New leakproof oil seals maintain internal pressure balance.

GEAR SIZE	SPEED (R.P.M.)	INPUT (G.P.M.) at input pressure psi 600	1000	1500	OUTPUT (H.P.) at input pressure psi 600	1000	1500
MC	600	0.8	1.4	2.4	4.1	4.7	5.3
SERIES	1000	1.3	2.4	3.4	7.1	7.4	7.7
1″	1500	1.9	3.5	4.5	9.6	10.4	10.8
MD	600	2.1	3.5	4.3	8.2	8.6	9.0
SERIES	1000	3.5	5.8	8.0	12.5	13.6	14.0
1″	1500	4.3	8.0	11.2	18.0	19.0	20.0
MJ	600	5.7	10.2	15.5	21.3	21.8	23.3
SERIES	1000	8.7	15.8	24.9	34.2	35.4	36.9
2″	1500	10.2	21.5	34.3	54.0	55.0	57.5

Performance data for MC and MD motors having gear widths other than shown above can be approximated by multiplying values in above table by width of desired gear; for MJ motors multiply by 1/2 the width of desired gear.

MC SINGLE MOTORS

3 gear widths, 1/2″, 1″, 1-1/2″.
4 round shaft sizes.
pedestal and 3 flange mountings.
tapped ports—side or end.

MD SINGLE MOTORS

7 gear widths, 1/2″, 3/4″, 1″, 1-1/2″, 2″, 2-1/2″, 3″.
8 round and 3 splined shaft sizes.
pad and 7 flange mountings.
tapped ports—side or end.

MJ SINGLE MOTORS

5 gear widths, 2″, 2-1/2″, 3″, 3-1/2″ and 4″.
1 round and 1 splined shaft size.
2 flange mountings.
tapped or split flange side portings.

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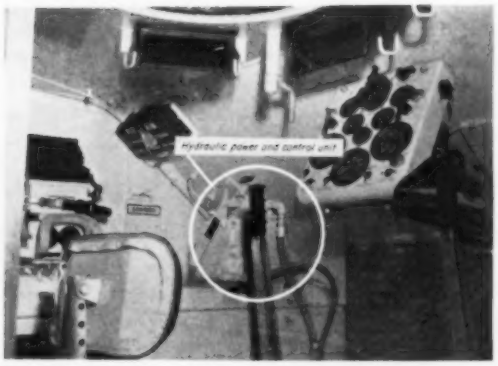
REAR of this vehicle is a hydraulically actuated ramp, hinged at the bottom. It's used for loading or unloading, and when closed it becomes the rear end wall of the vehicle, sealing it watertight.



COMPLETE control of ramp operation is from the control lever on the hydraulic valve. The lever is pushed in to raise, pulled out to lower. In neutral position the pump volume is bypassed to tank.

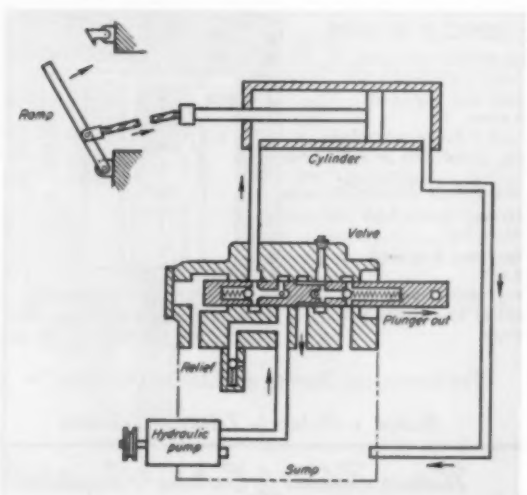
No Clutch For This Engine Driven Pump

REMOTE operation of a rear ramp from the operator's seat in the front of the armored vehicle is easily accomplished with oil power. Built by Food Machinery and Chemical Corporation in cooperation with Army Ordnance, the M59 is an armored box using crawler type track to propel it on land and in water.

With this simple, compact oil system, the pump is connected by a drive belt to an engine power take-off shaft. The valve arrangement permits oil to bypass to tank when the valve is in neutral. Since there is no power demand when the control valve is in neutral there is no need for a clutch to disengage the pump drive.

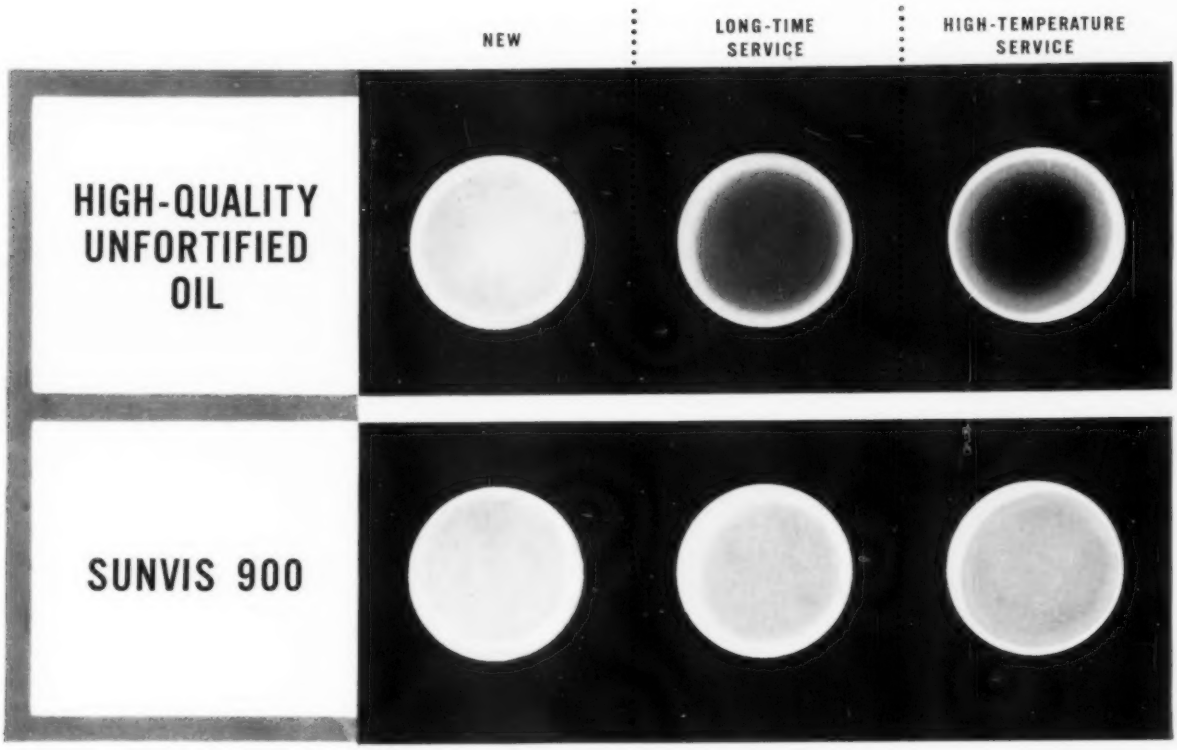
Because the hydraulic cylinder is used as an auxiliary reservoir, the size and weight of the hydraulic circuit is reduced. ▼▼▼

ARMORED infantry vehicle, the M59, carries 10 infantry men, their equipment, a driver and commander. The 50 caliber machine gun is mounted over the commander's seat.



COMPACT hydraulic circuit supplies fluid to the ramp operating cylinder to raise the ramp. Although the ramp actually lowers under its own weight, discharge oil from the cylinder is throttled to control the rate of lowering. 1200 psi oil pressure is applied for raising the ramp by the gear pump which is V-belt driven from the vehicle engine. A positive lock at the pump holds it closed and must be released to permit gravity lowering.

Courtesy The New York Air Brake Co.



Oil color tests show

WHY SUNVIS 900 OILS SAVE YOU MONEY IN CIRCULATING AND HYDRAULIC SYSTEMS

Color means very little in brand new oils. But...color *change* during service can mean a lot. While minor darkening is seldom serious, radical color changes indicate danger, except, perhaps, in a highly detergent oil.

Either the oil is contaminated by foreign matter, or as in the pictures, the oil has oxidized from heat and long use. The products of oxidation darken the color of ordinary oils...clog valves and filters, cause excessive maintenance.

Compare the appearance of the used Sunvis 900 with the appearance of the other used oil. The color of used Sunvis 900 is practically the same as new Sunvis 900. There is not a sign of oxidation products.

Here's proof that Sunvis 900 oils will last longer and provide the extra needed resistance against the high temperature "hot-spots" of typical hydraulic and circulating systems. *For the long run, a Sunvis 900 oil is the most economical oil you can buy.*

For more information about Sunvis 900 oils, see your Sun representative, or write for Technical Bulletin 35. Address SUN OIL COMPANY, Philadelphia 3, Pa., Dept. I-31.

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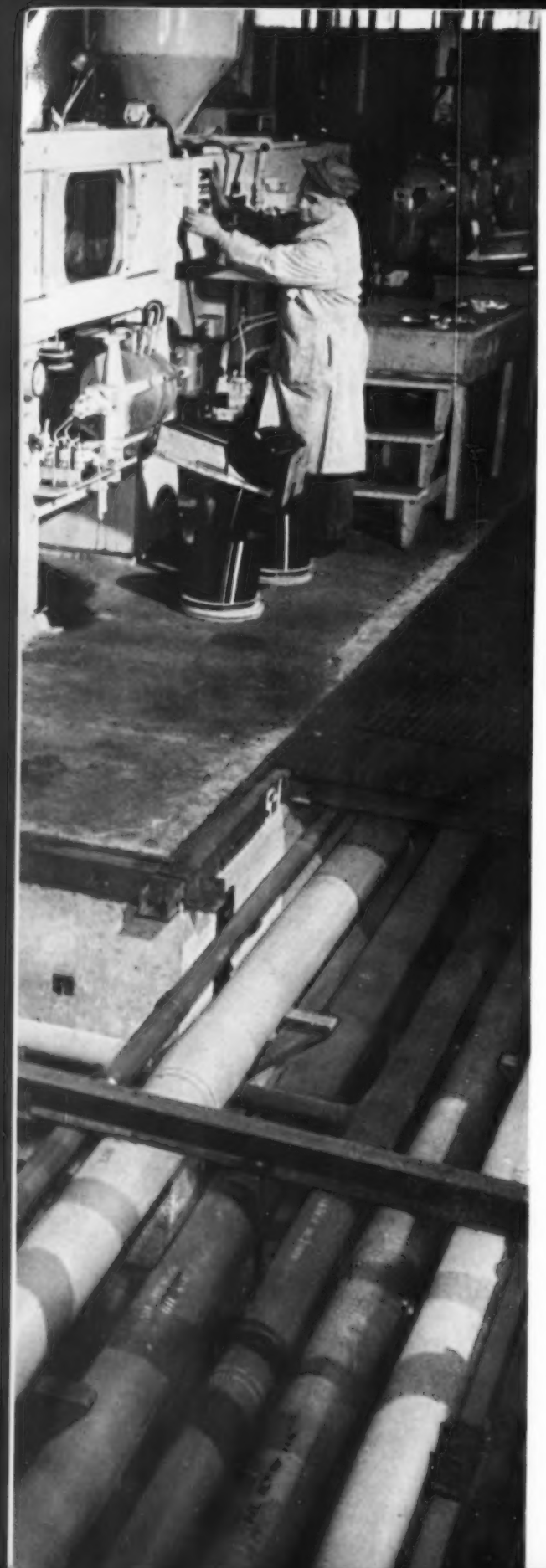
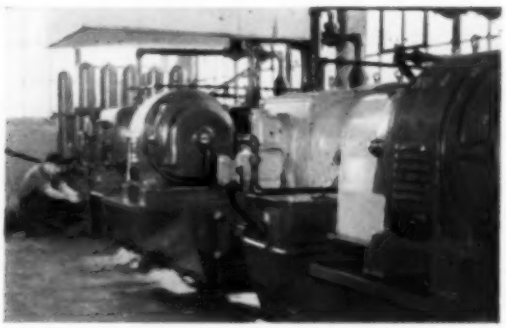


High-Pressure Pumps, below, each handle 54 gpm of Sunvis 931 at 2500 psi. Unique closed-loop hydraulic system, left, features color-coded piping.



NEW CENTRAL HYDRAULIC SYSTEM PROTECTED BY SUNVIS 931 OIL

The new variable-pressure hydraulic system at Columbia Records in Bridgeport, Conn., delivers oil at 2500 psi to as many as 40 injection molding machines. Round-the-clock production of micro-groove records depends on the reliability of this system.

Columbia picked Sunvis 931 because their tests and experience have shown it doesn't form carbon or leave harmful deposits...even after years of use. Because of their long life, Sunvis 900 oils are the least expensive oils you can buy for tight circulating systems.

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APPLIED HYDRAULICS

CIRCUIT DESIGN ARTICLE

SAFETY AND CONTROL IDEAS

. . . from a modern oil powered coal handling system

"Safe quick motions without shock"—how often must your design meet these requirements. Whether your job is to design a drive for a machine tool table, a fork lift truck or containers of coal, safety and controlled speed must be provided.

● By John R. Fawcett

ACCURATE control for positioning, speed, and automatic selection of operating cylinders are several of the design features built into a coal handling circuit. The circuit ideas used to modernize this mining operation can be readily adapted to many industries.

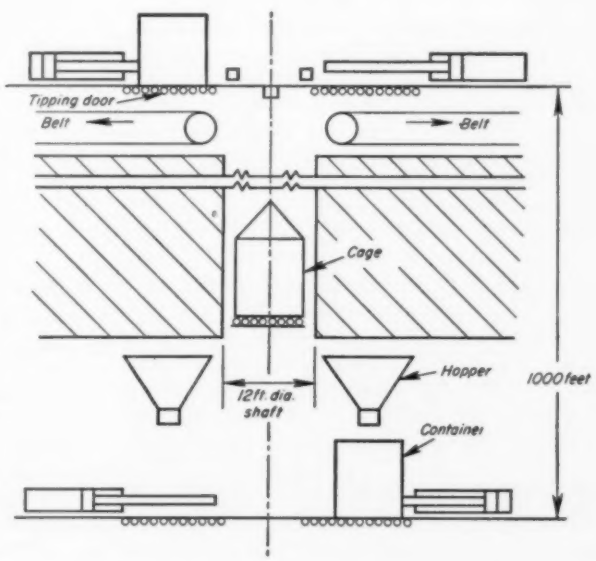
What the hydraulic system does in a recently modernized mine at Rawdon, England is briefly detailed in the drawing on this page.

Before this mine was overhauled, a maximum of 150 tons of coal per hour came out of two shafts. To get this production, 114 men and 650 rail tubs were needed. The new installation, using the oil hydraulic operated handling and belt conveyors has re-

What's the hydraulic system used for?

Coal has to be taken from the bottom of the 1000 ft shaft to the surface where it is dumped onto belt conveyors which carry the coal to distribution points. From belt fed hoppers, the coal is poured into light alloy, 5 ton capacity containers. A load arrives at the surface every forty-five seconds.

At the pit bottom, an oil driven cylinder pushes a full container into a waiting cage. As the full container enters the cage it pushes an empty off. The empty is hydraulically pulled into position under the opposite hopper. The cage is raised to the surface where an empty container which is pushed on, rolls the full container out. As the cage with the empty container descends, the hinged bottoms on the full container are opened by a hydraulic cylinder to empty the coal from the container onto the moving belt.



placed all the rail tubs with 6 containers. All but 16 men have been made available for actual coal mining instead of handling. Maximum tonnage, now 360 tons an hour, is taken from one shaft instead of two. So, it is apparent that the system, which has been in operation for almost two years, is completely successful.

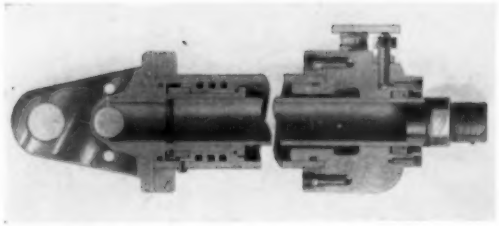
CIRCUIT COMPONENTS

Four similar hydraulic systems are used, two at the surface and two at the bottom. The two systems at the top are electrically interlocked, as are the two at the bottom, because one system in each case operates on one side of the cages and one on the other. This makes it possible for one cylinder to be used for decelerating the 5600 pound load after the cylinder on the other side has started the container moving. The circuit for half the surface installations is shown in the drawing on the opposite page. The other half is similar. The hydraulic equipment is located in four pump houses, one under each decking station, so that pipe runs are kept as short as possible. The electrical switchgear is contained in a cubicle and the hand operated controls are arranged on consoles, one at the surface and one below. The operator controls the safety catches independently but once he has initiated the container movement, the operation is carried out automatically. The oil tank is pressurized at 10 psi with clean filtered air to keep out coal dust. A small compressor is connected to the tank and this is controlled by a pressure switch. A float switch shuts off the electrical supply if the oil level falls too low. Each system has its own tank.

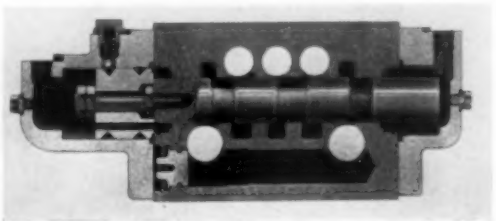
There are two pumping units for each circuit. The large container pushing cylinders are the biggest users of power and these are operated alternately from a single 52 gpm pump unit. A double pump unit which has capacities of 26 gpm and 3 gpm supplies oil for all the other services and the pilot system. When the system is idling, pilot pressure is maintained by the small 3 gpm pump blowing-off through a relief valve, which discharges through a backpressure valve at 75 psi. This back pressure is lead to an unloading valve which opens when pilot pressure is applied. If the demand exceeds the capacity of the small pump, the pressure drops and allows the relief valve to close and load the larger pump. To keep the oil clean, large filters are placed in the discharge line from the cylinders and relief valves.

ELECTRICAL CONTROL

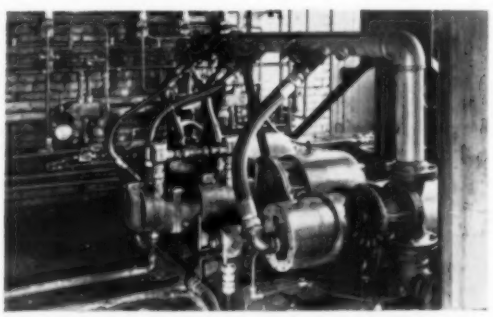
When the loaded cage stops at the surface, the operator secures the cage by the "kep" which supports the cage from underneath. He then starts the automatic cycle by pushing one of the buttons



One of 8 main rams used to position the containers. Forty cylinders are used in this mine installation. This cylinder has a phosphor bronze sprayed piston and hard chromed rod.



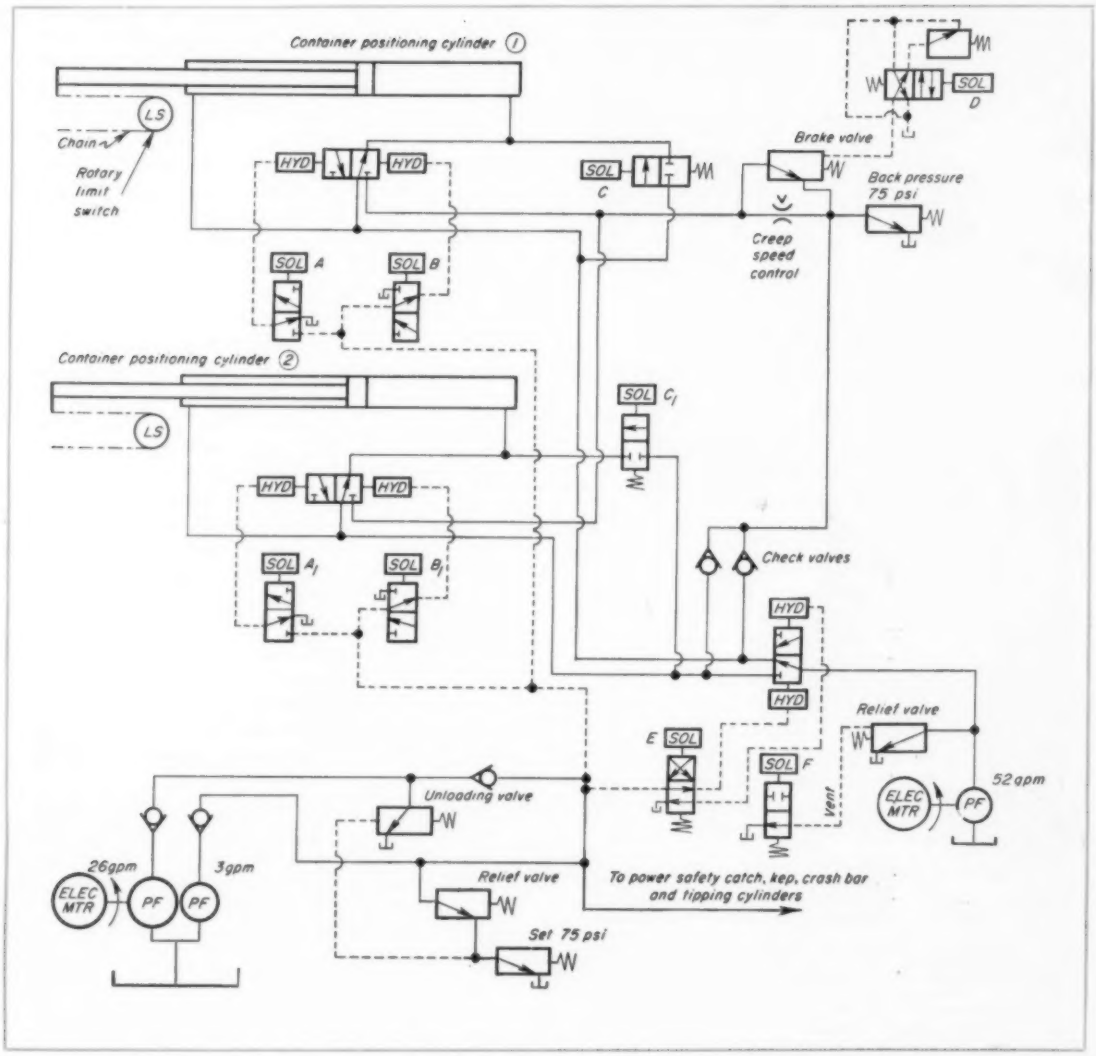
Only two types of directional valves have been used throughout the installation. This 5 port valve is pilot operated and detent located for positive positioning. Spring action is added to some of the valves in the circuit.



Pump layout in one of two identical pump houses on the top of the shaft. The 52 gpm main ram pump is in the foreground.

Keelavite Rotary Pumps & Motors Ltd., designed and supplied components for this system.

which control solenoid valves E and F. Solenoid valve E selects cylinder 1 or 2, depending on which cage is surfaced, and valve F loads the main pump relief valve. Pressure is applied to both ends of the container cylinder, which by the differential effect gives a fast speed of 2.4 fps. Valves A, B, and C are made with special pistons to control the speed when slowing down. The ram pushes the empty and full containers and also the ram on the opposite side of the cage, which acts as a brake. At first the oil from the back end of the retarding cylinder flows unrestricted through the unloaded braking valve. The limit switch deenergizes valve D towards



Container positioning cylinders are powered by a 52 gpm gear pump. Auxiliary cylinders and the pilot circuit get oil from the double pump. The 3 gpm unit is a gear pump; the 26 gpm unit is a rotary abutment type pump. Maximum working pressure, exerted only during acceleration of the containers, is 800 psi. The 52 gpm pump is unloaded through its vented relief valve when the rams are not operating.

the end of the stroke and connects the variable back pressure valve to the braking valve pilot. Opening pressure of the brake valve is determined by the external valve. Energy absorbed in stopping the containers is dissipated through the braking valve until they are slowed down to the creep speed set by the speed control valve. While the ram is moving back, the rod end of the cylinder is supplied with oil through one of the check valves at a pressure of 75 psi which is determined by the spring loaded back pressure valve.

The full container is not pushed clear of the cage. To completely pull the container from the cage onto the tipping section, each piston rod has a gripper which engages with a projection on the container. This pulling is done by the cylinder which acted as a brake in the first part of the cycle.

In the pushing cylinder, the pressure is acting on the 3 inch rod diameter only and the braking effect is on the 5 inch diameter of the opposing cylinder. The braking effect, therefore, is about three times that of the forward thrust for a given pressure.

The sequence of operations begins when the cage arrives at the surface. The exact position of the cage is proved by a "cage-in-line" limit switch and

Concluded on next page

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SAFETY AND CONTROL IDEAS

Concluded from preceding page

the circuits cannot be made until this is done. The cage also operates the "crash bar" valve to withdraw the crash bars which protect the open mouth of the pit shaft when the cage is lowered. The "kep", or support, is shot out under the cage to support the weight while it is stationary. In addition there are two more catches for each cage.

The sequence of operations is controlled by a rotary limit switch for each cylinder which is actuated by a chain wheel connected by chain to the container piston. Each of these special switches give six signals at the mine top and eight at the mine bottom. By driving the switches in this way they can be kept clear of dust and possible damage.

The tipping operation is carried out during the time that the cage is descending and rising and is therefore timed independently of the rest of the system. The tipping cylinder, when extended, holds up the door under the container through a toggle linkage. When the container is in the correct position over the tipping door, a limit switch starts an electric timer which controls the cycle of operation, including closing and extending the appropriate cylinder and then moving the container from the tipping position to a position close to the shaft. This operation takes 28 seconds.

Total installed motor horsepower is 300 but this is needed only for peak loads. Average requirement is 24 horsepower. The electricity consumption per 1,000 pounds of coal handled is only .1 kilowatt hour.

Safe and shock-free motions, and positive control of forces have been provided for this handling operation by circuits built with standard components which are easily serviced and maintained. The high power to weight ratio of hydraulic equipment permitted housing the necessary gear in a comparatively small area. ▼▼▼

DESIGNING HI-LO CIRCUITS

Concluded from page 56

small volume pump continues to supply the required output.

Radial piston, variable delivery pumps are available for pressures to 3000 psi. Units are available with a radial piston pump mechanism, a gear pump and gear pump relief valve for supercharging the system and operating hydraulic controls and auxiliary equipment enclosed in the pump case. The unit also incorporates high pressure relief valves to protect pump, work and machine against overload. ▼▼▼

This article is based on material contributed by American Engineering Co., Double A Products Co., Denison Engineering Co., Dudco Div. New York Air Brake Co., Oilgear Co., Racine Hydraulics & Machinery, Inc., Standard Machine & Tool Co., and Vickers, Inc.

HOW TO SALVAGE PRESS PISTON RODS

Here's an idea which has saved the Norton Company many dollars in hydraulic press maintenance and downtime costs.

SCORED 2½ inch diameter, 32 inch long piston rod before repair.

ABRASION is one of the worst enemies of hydraulic plungers. Gritty particles from the atmosphere which may find their way into packing glands can score a piston in a short time. Probably no worse wear condition could exist than in a plant making abrasive products.

In spite of carefully shielded equipment, Norton Company found that plungers in presses used to manufacture grinding wheels cannot be completely protected from particles of abrasive grain. As a result, plungers must frequently be repaired or replaced.

Formerly such parts were either ground undersize or replaced. Now, however, these parts are salvaged at a fraction of original cost by metalizing.

The worn plunger is rough turned on a lathe, undercutting the ends to insure good bonding of the sprayed metal. Then stainless steel wire is used in the metalizing gun to build up the surface. After grinding to original size, the plunger is again ready for service. The whole operation can be done in a matter of hours. Former methods of repair took days (or even weeks if a replacement part had to be ordered).

Metalizing has several advantages over other methods of salvage. In this case stainless steel provides a better wearing surface than the original steel. Because of the thickness of the metalizing surface, there is not the danger of the surface flaking off as in the case of plating. Metalizing restores the shaft to original size. When grinding undersize, as was formerly done, pressure gages on the press had to be recalibrated to compensate for the smaller diameter. All that extra work is now eliminated.

Norton has found that by following the recommendations of the metalizing equipment manufacturer, excellent results can be obtained. Even though used only occasionally, this equipment has paid for itself by shorter down time, reduction of scrap, and longer lasting wearing surfaces. ▼▼▼

AFTER ROUGH turning, the piston rod is metalized. Eight pounds of stainless steel wire were used. For this rod it took 45 minutes to prepare the surface and spray on the metal. Finish grinding took about the same time.

PUMP performance was greatly reduced by this rusting of the ring. Slippage increased causing horsepower loss and overheating.

BADLY rusted valve spool shows the effects of moisture in a system. A rust inhibited oil would have prevented this.

Internal rusting of hydraulic components is caused by contamination and condensation from air in the system. You can't make the system airtight, but you can add an inhibitor to the fluid to . . .

PREVENT RUST

in hydraulic systems

IT TAKES only one or two flakes of rust passing through precision pumps and valves to scratch surfaces enough to reduce the efficiency of these components. A scratch on a pump piston can cause an excessive amount of slippage resulting in horsepower loss and overheating. Air enters a system through leaks on the intake side of pumps, vents in the reservoir, contamination, and other sources. Condensation from this moisture causes rust in the system, and the only practical method of preventing this rust is to provide an internal protective coating on the system components. Suitable compounds called polar inhibitors have been developed for this purpose. Although the chemical action of these inhibitors is not clearly understood, it is believed that they "plate out" on the metal surfaces, forming an adherent film which is impervious to the rusting action of water and air.

Only a small amount of rust inhibitor—less than 1% solution—is sufficient to protect the metal surfaces of a system, even though it may form a coating no more than several molecules thick. The performance of these rust inhibitors is particularly evident in humid climates where rust has proceeded at an abnormal rate. In such cases rusting problems have been entirely eliminated by the use of rust inhibited oil.

Once the metal parts of a hydraulic system are coated with the inhibitor, they are impervious to water from condensation or contamination, even though they are not constantly submerged in oil. For long periods of lay-up, however, other preservative materials are required. The protective film can be removed by the use of any mineral oil which is not rust inhibited. Apparently an equilibrium is set up between the amount of inhibitor plated out and that remaining in the oil. If a straight mineral oil is used for make-up after an initial charge of rust inhibited oil, the inhibitor which has plated out will go back into the make-up oil. ▼▼▼

Information included in this article has been supplied by The Texas Co.

HYDRAULICS BASIC ARTICLE

Why is precise constant speed output from a hydraulic transmission hard to obtain?

Why is fairly reliable constant torque output easily provided?

Here's a basic analysis showing how pressure and flow influence . . .

SPEED AND TORQUE OUTPUT

. . . from hydraulic transmissions

● By Dennis W. Prosser

In this article, leakage, pressure drops and heat losses are neglected and pumps and motors are assumed to be 100 per cent efficient. While this simplification doesn't detract from a basic discussion, it would be understood that the adverse influences of these factors on any hydraulic device is an important problem which industry is constantly striving to minimize.

USE of a few equations which relate capacity, displacement, speed, pressure, and torque is the basis of understanding characteristics of hydraulic transmissions. Derivation of these equations can be found in most elementary fluid mechanics textbooks and in the Technical Section of the APPLIED HYDRAULICS Master Catalog of Fluid Power Products.

These equations apply to both pumps and motors:

$$Q = DN, \quad \text{.....(1)}$$

$$T = \frac{(p_1 - p_2)D}{2\pi}, \quad \text{.....(2)}$$

and

$$T = \frac{(p_1 - p_2)Q}{2\pi N}, \quad \text{.....(3)}$$

where Q = flow rate through pump or motor (in^3/min).
D = pump or motor displacement per each revolution of the shaft (in^3/rev).
N = rotational speed of pump or motor (rev/min).
T = torque applied to pump shaft or derived from motor shaft (in-lb).
π = 3.14
p_1 = pressure on outlet side of pump or inlet side of motor (lbs/in^2).
p_2 = pressure on inlet side of pump or outlet side of motor (lbs/in^2).

Some distinction must be made between pump and motor properties. For example, with the pump putting out 500 in^3/min there may be only 400 in^3/min flowing through the motor, the other 100 in^3/min having left the circuit by way of the maximum pressure valve. Figure 1 labels the flow rates through pump and motor as Q_p and Q_m respectively, since they are not necessarily similar. In like manner the rotational speeds, torques, and displacements are distinguished by subscripts p for pump and m for motor; that it, N_p, N_m, T_p, T_m, and D_p and D_m.

From Figure 1 it is apparent that the pressures at pump inlet and motor outlet are both equal to zero, hence p_2 can be eliminated from the equations. Furthermore, the pressures at pump outlet and motor inlet, that is, between pump and motor are the same and will retain the designation p_1.

Based on the above considerations the equations are written separately for pump and motor.

PUMP		MOTOR	
$Q_p = D_p N_p$	(1A)	$Q_m = D_m N_m$	(1B)
$T_p = \frac{p_1 D_p}{2\pi}$	(2A)	$T_m = \frac{p_1 D_m}{2\pi}$	(2B)
$T_p = \frac{p_1 Q_p}{2\pi N_p}$	(3A)	$T_m = \frac{p_1 Q_m}{2\pi N_m}$	(3B)

Motor torque, T_m, results from the load to which the transmission is coupled and produces the line pressure, p_1, between pump and motor, in accord-

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DENNIS W. PROSSER, *formerly Secretary National Conference on Industrial Hydraulics and Instructor, Illinois Institute of Technology, presently in the U. S. Army.*

ance with equation (2B). Pump torque, T_p, is supplied by the electric motor. The speed of the electric motor and, consequently, pump speed, Np, are constant under the assumption of ideal conditions. In reality the electric motor's speed would vary slightly with changing loads. This is but one of many reasons a constant speed or constant torque transmission has never been fully realized.

Now to consider four transmissions derivable from various pump and motor combinations.

1 CONSTANT DISPLACEMENT PUMP AND CONSTANT DISPLACEMENT MOTOR.

Equation (1A) shows pump discharge, Q_p is constant since pump displacement and speed are both constant. From Figure 1 it is apparent that Q_m is equal to Q_p minus Q_r; thus Q_m will vary with Q_r. Motor speed, N_m, will also vary with Q_r since it is dependent upon Q_m (see Equation (1B)).

When no load is being applied to the motor shaft the torque T_m is zero and, from equation (2B), the line pressure p_1 is also zero. Under these conditions the maximum pressure valve remains closed, hence Q_r is zero and Q_m equal to Q_p. Motor speed, N_m, can then be calculated from equation (1B), by replacing Q_m with Q_p.

As an increasing load (torque) is gradually applied to the motor shaft, both T_m and p_1 increase until the maximum pressure valve setting is reached. During this time no flow has occurred through the maximum pressure valve, so the motor speed remains the same as for no-load conditions. Further increase in load will cause the motor to slow down and eventually stall, since the maximum pressure valve limits the line pressure, p_1, and consequently the available torque T_m.

A constant displacement pump and motor combination performing work on a load too small to open the maximum pressure valve will operate as a constant speed-variable torque transmission. However, the torque variation is due to load changes and not controllable by the transmission. This type of application is quite restrictive to the transmission.

To obtain the full worth of hydraulic transmissions they are normally operated with the maximum pressure valve open. To accomplish this, estimate an average required motor torque, T_m, and use that value in equation (2B) to determine the corresponding line pressure, p_1. The maximum pressure valve is then set to open at that pressure. Now, when T_m corresponds to this estimated average, the valve is held open. If the load, and consequently T_m, were to increase slightly the motor would slow down and, according to equation (1B), the flow rate Q_m would decrease. More oil would be required to pass through the relief valve since the pump output remains constant. This increased capacity cannot be handled by the relief valve until the line pressure builds up slightly which would cause the valve opening to increase. While the pressure, p_1, builds up to open the valve it also increases the motor torque, T_m, (equation (2B)) which will either meet the immediate increased torque demand and return the system to normal or the motor will stall.

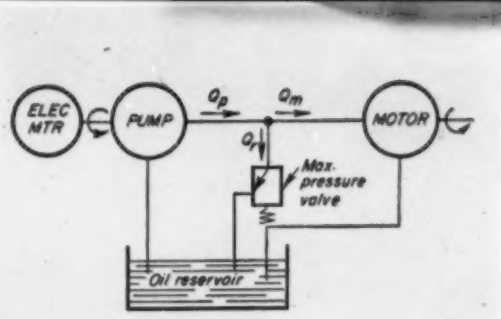

FIG. 1. A TYPICAL hydraulic transmission circuit has a reservoir between pump and motor to minimize overheating the oil and a maximum pressure (relief valve) to prevent damage of circuit components. A constant speed electric motor coupled to the pump provides power.

For most applications that employ a constant displacement pump and motor combination the recovery just described would occur so smoothly and quickly that the transmission would normally be classified as having constant speed-constant torque characteristics. Maximum pressure valves can handle a fairly large capacity range with little variation in line pressure. In terms of the present consideration this means that excessive overloading could cause the motor to slow appreciably with little change in torque. In other words, this type of transmission is more positive in its constant torque characteristic than it is in its constant speed characteristic.

Since transmission characteristics determined by the hydraulics industry are normally based on an open maximum pressure valve, the remaining discussions will be based upon the further assumption that the line pressure, p_1, is constant.

2 VARIABLE DISPLACEMENT PUMP AND CONSTANT DISPLACEMENT MOTOR.

With variable pump displacement, D_p, it is apparent from equation (1A) that pump discharge, Q_p, and, consequently, flow through the motor, Q_m, are both variable. From equation (1B) the transmission can be classified as variable speed.

The motor torque, T_m, is constant by virtue of equation (2B) and the fact that p_1 and D_m are both constant. A variable displacement pump and constant displacement motor provides a variable speed-constant torque transmission.

3 CONSTANT DISPLACEMENT PUMP AND VARIABLE DISPLACEMENT MOTOR.

With constant pump displacement, D_p, equation (1A) shows that pump discharge Q_p is constant. Then Q_m varies with Q_r, since Q_m is equal to Q_p minus Q_r. If Q_r, and thus Q_m, were to remain constant the transmission would supply constant speed because of equation (1B). However, as considered

previously, Q_r may vary appreciably under severe overload due to the relief valve characteristics. This once again points out the difficulties encountered when attempting to obtain a constant speed transmission.

From equation (2B) the transmission is determined to provide a variable torque characteristic. Thus a constant displacement pump and variable displacement motor yields a constant speed-variable torque transmission.

4 VARIABLE DISPLACEMENT PUMP AND VARIABLE DISPLACEMENT MOTOR.

This pump-motor combination represents the most versatile transmission available; from it any one of the other types can be obtained by holding pump and/or motor displacement constant. Consideration of the previous results indicates variable displacement pumps yield variable speed characteristics whereas variable displacement motors yield variable torque characteristics. Consequently, the variable displacement pump and motor combination yields, as its most versatile characteristic, a variable speed-variable torque transmission.

A unique constant speed-variable torque transmission can be obtained by providing a device to vary both pump and motor displacement by equal amounts at all times. That this would provide constant speed is apparent from consideration of equations (1A) and (1B). The motor torque would vary according to equation (2B). ▼▼▼

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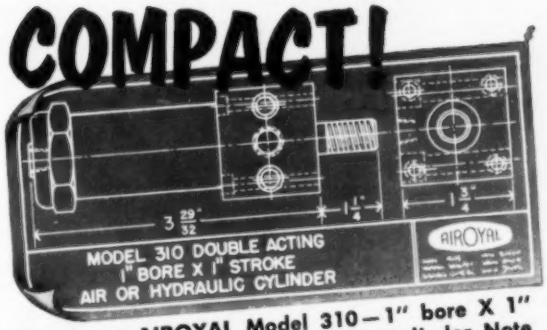

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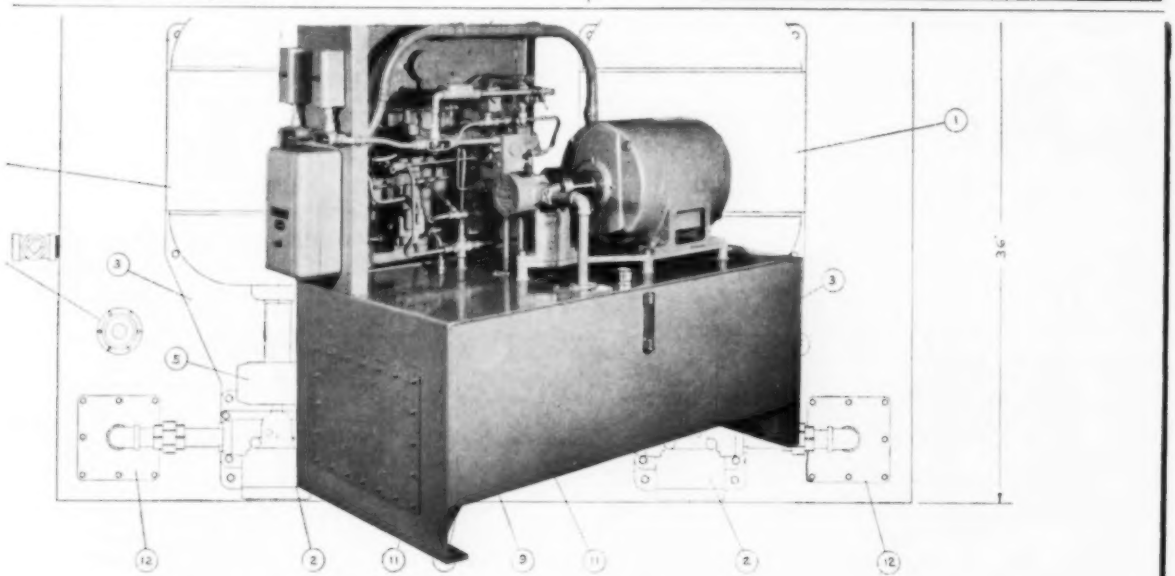

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CIRCUIT DESIGN ARTICLE

SERIES CONNECTED CYLINDERS FOR SYNCHRONIZED CONTROL

. . . with an overload detector device

• By Robert E. Raymond

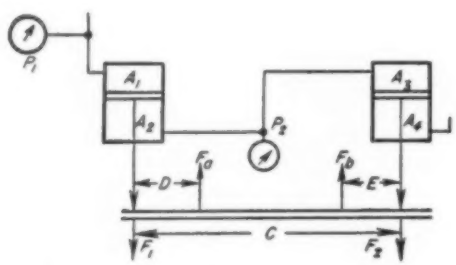
SYNCHRONIZED operation of cylinders can be accomplished with a high degree of accuracy and stability regardless of load variation—if—properly sized, tight, series connected cylinders are used and a recharging system to eliminate accumulative error is devised.

This particular circuit was developed to pull or push a load consisting of two concentrated loads connected to the pulling draw bar at two separate fixed points between two parallel hydraulic cylinders. These loads can vary in magnitude in an arbitrary manner. However, neither load can be allowed to exceed a certain fixed value. The two hydraulic cylinders must move exactly together over a stroke of approximately 13 feet. To eliminate any bending stresses in the material being drawn or in the drawing mechanism, the hydraulic pistons must share the load over the entire stroke.

To lock the two cylinders together in parallel feed, without elaborate feedback or servo control, they are connected in series. A linear movement of one causes the same linear movement in the other.

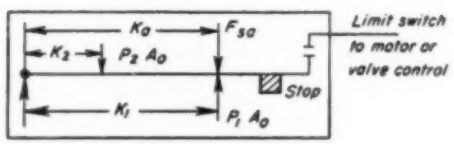
ROBERT E. RAYMOND, *Project Engineer, Simplex Engineering Co., Zanesville, O.*

HOW TO DETECT A SYSTEM OVERLOAD

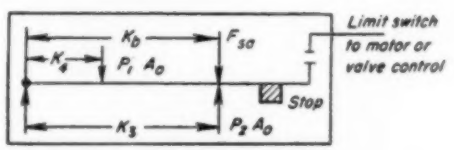


For this job overload protection can not be adequately provided by relief valves or simple pressure switches because they would not sense load distribution. It is possible for the pressure reading to be the same for a condition of overload as well as for a safe load depending on where the loads are concentrated. Therefore, the overload device must detect variations in bending moments.

F_a and F_b are loads applied at points between the cylinders. These loads are arbitrary in size. The pulling must be interrupted, however, when either or both of these loads reach F_c which is the allowable critical value. As the draw bar moves out, F_a and F_b effect the distribution of the load on the two



F_a DIFFERENTIAL MOMENT DETECTOR



F_b DIFFERENTIAL MOMENT DETECTOR

All off-the-highway earth-moving equipment... dozers, scrapers, dump trucks... pose special hydraulics problems. The bulk, tonnage, and rugged service impose conditions that shoot an "ordinary" or "standard" formula full of holes. This is true of all heavy-duty equipment and especially so with long-stroke telescopic cylinders!

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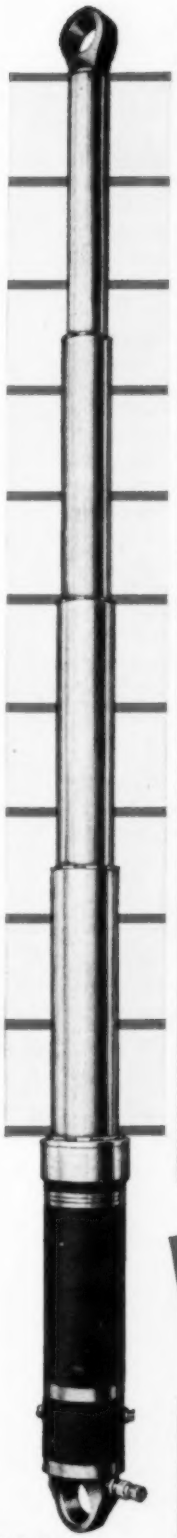

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One of these builders is the Dart Truck Company, Kansas City, Mo., whose new 75-Ton capacity dump body is shown here. This model uses two 120-inch stroke HYDRECO Telescopic Cylinders. Fluid Power for the circuit is provided by two HYDRECO Pumps and control is by means of a HYDRECO Hollow-Plunger Valve.

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cylinders exactly as the bending moments dictate. The pump pressure, P_1 and the trapped pressure P_2 also vary as the load bending moments dictate.

The two system pressures P_1 and P_2 are used to detect whenever F_a or F_b reach the critical value F_c. These pressures P_1 and P_2 are fed into a device that compares them against a reference. The detecting device is itself, a system of bending moments. Since F_a and F_b are two independent variable forces, there are two independent system equations and there must be two independent comparing devices or detectors. These detectors are called "differential moment detectors" because they are continually comparing bending moments caused by two varying pressures against a reference bending moment for the overload protection.

In the overload circuit, the two detectors are in series through a relay to cut the power if either critical point is reached. When the power is cut, it must be restored again by separate push button control, after the trouble has been eliminated at the detectors.

In order to determine a system or device for continually detecting F_a and F_b in terms of P_1 and P_2 for overload protection, it was necessary to develop and analyze load bending moment equations.

The detector device selected uses standard piston diaphragm pressure switches applied at two points on a moment arm in the correct manner. The switches are balanced with a set spring force at the correct moment arm. The reference moment is set according to derived equations:

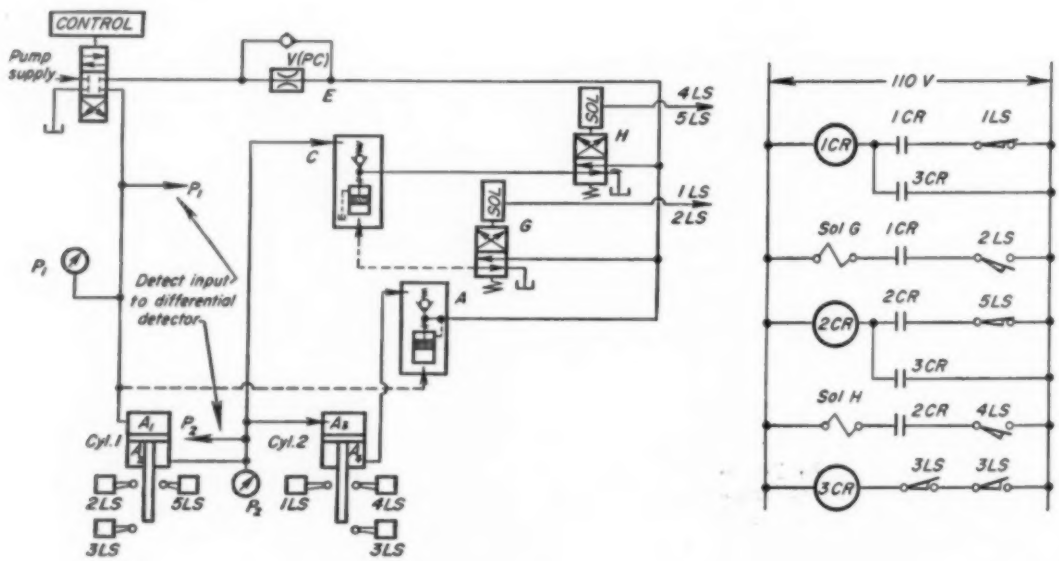
$$F_{sa} = \frac{F_a A_o}{K_a} \qquad \text{and} \qquad F_{sb} = \frac{F_b A_o}{K_b}$$

Where F_{sa} and F_{sb} are spring forces, A_o is area of piston type pressure switch diaphragm, and K_a and K_b are moment arms.

Choosing a suitable spring force, determines K_a and K_b to satisfy the equation. Whenever a balance of moments occurs, the power is cut by the switch movement.

This system enables two cylinders to pull two arbitrary loads evenly with individual load governing protection for each load. It is then possible to pull a maximum load which is continually varying in its magnitude and its position between two pistons without danger of overload damage.

HOW TO ELIMINATE "OUT-OF-STEP" MOTION



The only two factors that can cause a discrepancy of parallel movement are leakage and the compressibility of oil. This is assuming there is no expansion of the cylinders. Compressibility effect is negligible under moderate pressure and volume conditions.

Cylinder leakage under normal pressure can be practically zero over one stroke when using a properly designed cylinder. Accumulative leakage is the only concern. To accommodate this condition it is necessary to design a recharging circuit that would insure a correction for any increment of leakage that might occur over any one stroke. This action prevents any possible accumulative error in the

locking column over a number of strokes.

The recharging circuit includes the two pilot operated checks, the two solenoid operated-two position valves, and the necessary electrical controls. The object is to isolate the locked oil column between cylinders during the entire cycle, from any sources of leakage other than the pilot operated check (C). However, when the pistons return, the recharging circuit is to cut in for the correction that is necessary at the end of the stroke.

If piston 1 returns first, 5LS opens to prevent (H) from operating and 2LS closes which opens (G) and allows excess oil to return to tank. When piston 2 is fully back, 1LS trips to close (G) and correction is complete.

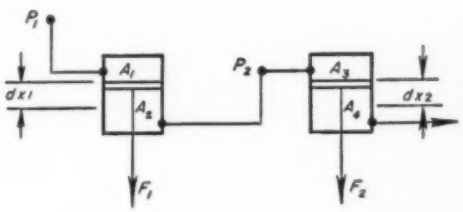
If piston 2 returns first, 1LS opens to prevent check (C). However, when the pistons return, the opens (H) and allows oil to be sequenced in to make up loss in the trapped column. When piston 1 is fully back, 5LS opens which closes (H) and the correction is complete. The 3LS is solely for resetting the correction circuit after forward stroke is under way. This prevents solenoids from actuating when the cylinders begin the forward stroke.

HOW TO SIZE TWO SERIES CONNECTED CYLINDERS

A_1 = Bore area cylinder 1
A_2 = Annular rod side area
A_{r1} = Rod area cylinder 1
A_3 = Bore area cylinder 2
A_4 = Annular rod side area cylinder 2
A_{r2} = Rod area of cylinder 2
P_1 = Pressure at bore side cylinder 1
P_2 = Pressure at bore side of cylinder 2 and annular rod side of cylinder 1

Suitable relationships between bore and rod areas are important. The choice of rods capable of withstanding maximum column effect is the starting point of the system design. Further requirements are:

1. Absolutely—$A_2 = A_3$
2. Preferably—$Ar_1 = Ar_2$ (Rod areas)
3. Preferaby—$A_1 = \frac{3}{2}A_2$ (Limit intensifier action)
4. Preferably—$A_4 = \frac{1}{3}A_1$ (to give adequate pressure differential for return stroke)
5. All bores and rod diameters must come within standard packing dimensions.



These restrictions give two equations for selecting the cylinders once the rod size is chosen:

1. $D_1 = \sqrt{3D_{r1}^2}$
2. $D_2 = \sqrt{2D_{r1}^2}$

These relations fix the locked series circuit and determine the pump pressure and gpm to be required for a given total load. ▼▼▼

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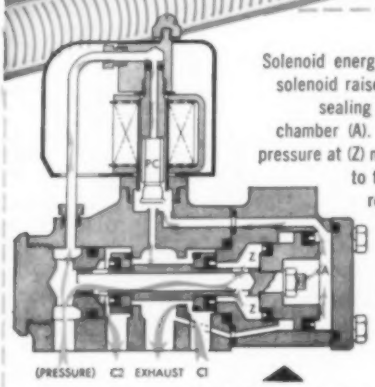
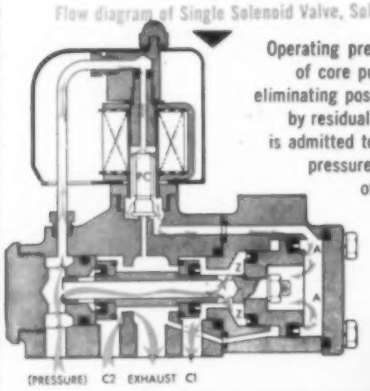


Solenoid energized — energizing the solenoid raises the pilot core (PC) sealing the pressure inlet to chamber (A). (A) is exhausted and pressure at (Z) moves the valve piston to the right. Pressure on resilient inserts forces them against the metallic junction of disc and seat in an absolutely tight seal.

Flow diagram of Single Solenoid Valve, Solenoid Energized

Flow diagram of Single Solenoid Valve, Solenoid De-energized



Operating pressure applied to top of core pushes it off the seat, eliminating possible sticking caused by residual magnetism. Pressure is admitted to (A). While the same pressure exists on both sides of the piston, (A and Z) the area on the right is greater. The resultant force moves the piston to the left.

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Seated at our roundtable are . . .

Addison T. Smith, *The Airoyal Co., Maplewood, N. J.*

R. E. Lancaster, *vice president in charge of engineering, The Weinman Pump and Supply Company, Pittsburgh, Pa.*

James M. Grimstad, *J. M. Grimstad Company, Milwaukee, Wis.*

Paul Locklin, *Alta Engineering Company, Denver, Colo.*

Ralph W. Moss, *sales manager, Haskel Engineering & Supply Co., Glendale, Calif.*

• WHAT INDUSTRIES IN YOUR AREA ARE USING FLUID POWER?

Bob Lancaster: In the Pittsburgh area, the steel and coal industries are the hub around which has grown a large group of manufacturers who build equipment for producing steel and coal. Major builders, like Mesta, Joy, United, Aetna, Blaw-Knox and Mathews are building rolling mill equipment, conveyors, manipulators, furnace charging machines and coal machinery. Many small and medium size companies have entered the equipment building field to keep pace with modernization of the coal industry and expansion in the steel industries. Oil power is widely used on new automatic mining and material handling equipment. There are new demands for improved methods, higher speeds, greater reliability, less maintenance.

Ad Smith: The industry picture in the New York City area is quite different from Pittsburgh. Here is a very diversified industrial area—aircraft, paint, leather working, plastics, electronics—companies which are small in comparison to the steel producers. There are few companies who build a standard line of original equipment. The many special machine builders use fluid power, but

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FLUID POWER ROUNDTABLE

require considerable assistance for their "one machine" production. Because some of America's largest corporations maintain development and central engineering departments in or near New York, the fluid power sales engineer "gets in on the plans" of many plants across the country. This often means a lot of time and thought spent on projects which never pan out. But, like almost everywhere else in recent years, the growth in this area has been explosive. Fluid power has made a large contribution in the increase of productivity per worker.

Jim Grimstad: Manufacturers of machinery are the largest employers in Wisconsin. Then comes electrical machinery, paper and allied products, metal fabricating, primary metal industry and lumber and wood products. Manufacturers of machine tools, earth moving machinery and farm equipment are large users of fluid power on their products. In-plant applications of air and oil are common to all the industries.

Paul Locklin: The entire Rocky Mountain area is experiencing a tremendous business boom made up of oil and gas exploration activities, uranium processing, Atomic Energy Commission activities, and a whole flood of new companies in the industrial and manufacturing field. The oil and gas indutsries estimate that their rate of spending in Colorado alone has increased 50 times since 1950 Aircraft missile accessory firms are moving in along with manufacturers of related electronic equipment. Food processing and primary metals are the major industries in Colorado.

Ralph Moss: Aircraft is still the big industry within Southern California. This, plus its many sub-contractors and suppliers accounts for a good share of the business for fluid power components. The guided missile portion of aircraft, including the basic research groups like Cal Tech and U. S. Navy Ordnance are showing great strides in development.

● **HAS THERE BEEN MUCH MOVEMENT OF INDUSTRY?**

Ad Smith: We have had a migration of industry, but it has been a local migration. Many concerns located in metropolitan New York and in the Newark area have moved to the suburbs. This migration is always accompanied by and brought on by the need for expansion. Movement to the suburbs is common throughout the east and middlewest where older companies need a fresh start with more space. Modernization of equipment and techniques goes hand-in-hand with this migration—in many cases this means new in-plant applications for fluid power.

Our area has not been affected much by the "moving in" of new industries. It has been affected by the moving about of companies already here. For example, Ford has moved operation from Edge-

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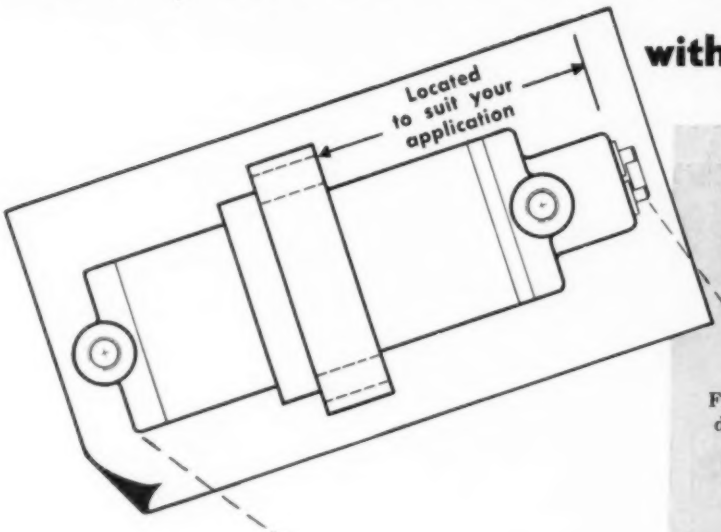
with **Pathon INTERMEDIATE FLANGE MOUNTING HYDRAULIC CYLINDERS**



Application of the Pathon Intermediate Flange Mounting, as shown by the simplified drawing below, saved this machine company 25% of their base casting cost. Bonus advantages included reduced shipping weight, easier handling, and the universally recognized operating efficiency inherent in all Pathon Cylinders.

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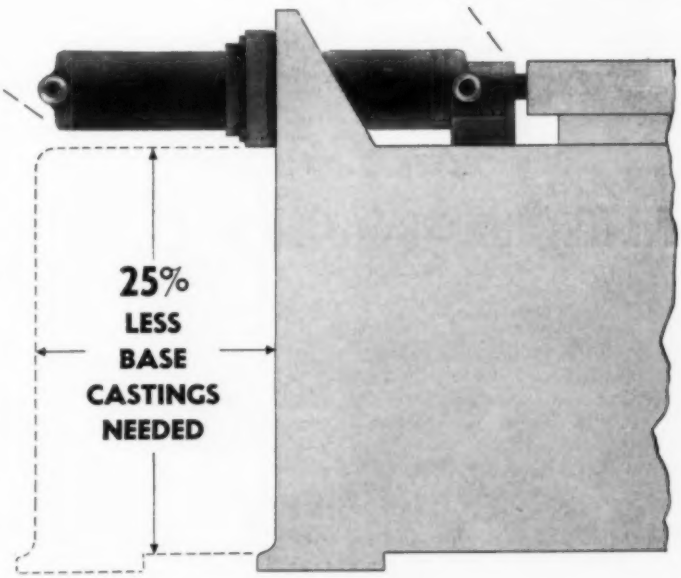

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*TRADE-MARK

water, N.J. to a much larger plant in Mahwah, N. J.; Cameron Machine Company (paper Machinery), while retaining an operation in Brooklyn, has moved a substantial part to Dover, N. J.

While expansions and short distance moves seem to be the rule, a few companies have moved out of the area. For example, Shick has moved from Connecticut to Pennsylvania. Westinghouse Electric Meter has moved part of their operation from Newark to North Carolina.

Bob Lancaster: No major industries have moved from this area since 1950. Pittsburgh's active modernization program has attracted many new companies.

Jim Grimstad: We would estimate that since 1950 the use of pneumatic and hydraulic equipment is practically doubled in this area. New companies including American Can, G. E. X-Ray, Hotpoint, and Continental Can along with others, account for about 3400 new jobs. Fairly general expansion of such companies in the machinery manufacturing line account for an estimated 2500 new jobs.

A considerable number of textile and shoe manufacturing industries moved from this area with an estimated loss of 2000 jobs.

Paul Locklin: Recent industrial additions in Colorado include a 5 million dollar plant of Sundstrand Aviation Div. From Buffalo, the Stanley Aviation Corp. has moved its operations to Denver. Glenn L. Martin will be locating a 500,000 square foot guided missile and aircraft products plant outside of Denver, for which employment of 5000 is estimated within four years. Ramo-Wooldridge will build an electronics plant nearby. New plants have been built in the area by American Can, Colorado Fuel and Iron Corp, Continental Can, Gates Rubber, Micro-Switch Div., and Standard Furniture.

Compared to the east coast, middle-west, and Southern California, industrial activity in this Rocky Mountain area is just under way.

Ralph Moss: Electronic manufacturing will prove to be a great factor in our economy with giants like Hughes and Ramo-Wooldridge. Feeder plants of specialized electronics are also springing up almost overnight, relay manufacturers, instrument plants, etc.

The automotive industry is taking steps to enlarge their scope of activities in Southern California and their move toward local purchasing of components should bring new business.

The one basic line of manufacture not too well represented in this area is machine tool. We have a few small manufacturers of punch presses, hydraulic presses, and welding machines, plus two specialized builders of hydraulic stretch presses. The present potential for fluid power in this line is not great.

All of this growth has increased the need for

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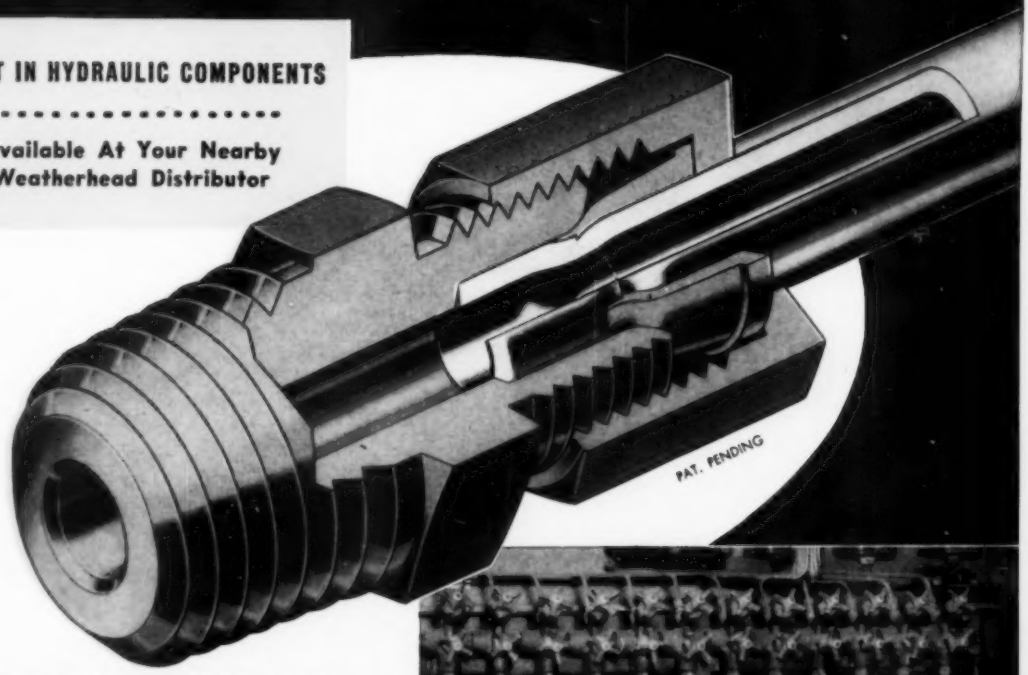

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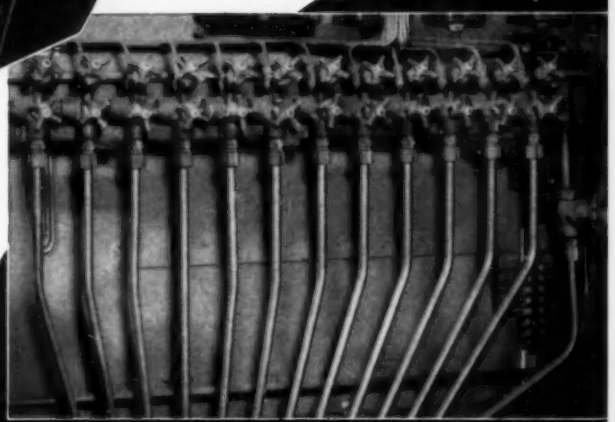

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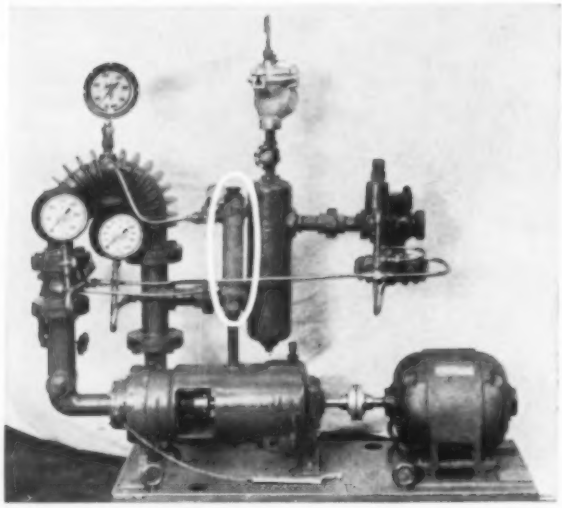
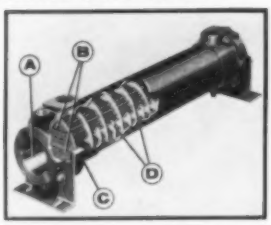


Young Coolers cut line losses

in condensate return pump system



Young Type "F" Shell and Tube Heat Exchanger

THE PROBLEM: To eliminate line losses between process equipment and Cochrane Condensate Booster Drainage Control Units.

How Young solved it

Young Type "F" Heat Exchangers were specified to reduce water temperature 5 degrees before mixing it with incoming condensate at the mixing tube. Lowering the temperature of the fluid entering the mixing tube offsets line pressure losses . . . boosts pump efficiency.

A. Smooth flow bonnet distributes fluid with minimum turbulence.
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Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.

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hydraulic and pneumatic equipment. This coupled with the new field of automation in industry makes us believe fluid power will be strong in Southern California. Many jobs are now being done with hydraulic power and pneumatics that were formerly manual or mechanical.

• **ASIDE FROM GROWTH OF INDUSTRY, WHAT ARE SOME OF THE FACTORS LEADING TO INCREASED USE OF FLUID POWER?**

Ad Smith: More people are getting to know about the dependability and exceptional degree of control obtainable with fluid power. In the past, there was more hesitation about using fluid power because—"we tend to avoid that which we do not know".

Development of fire-resistant fluids, for jobs where there is a real risk is a growing factor. And then there's the catchword "automation" operations. Many processes do not, fortunately, require an all-out program, and "automating" can proceed on a piecemeal basis. One of our best examples of this piecemeal automation is in a large steel drum reconditioning plant. It is a realistic approach to "volume" production as differentiated from Detroit's "mass" production.

One trend in the application of fluid power is in the direction of servo control to give automatic correction of speeds.

Bob Lancaster: Previously mechanically powered equipment is being converted to fluid power because of lower initial cost, higher speeds, better control, less space and weight, simpler maintenance, lower operating cost and greater efficiency.

Because downtime can be terribly expensive in the steel industry every effort is made to facilitate repairs, maintenance and fail-safe operation.

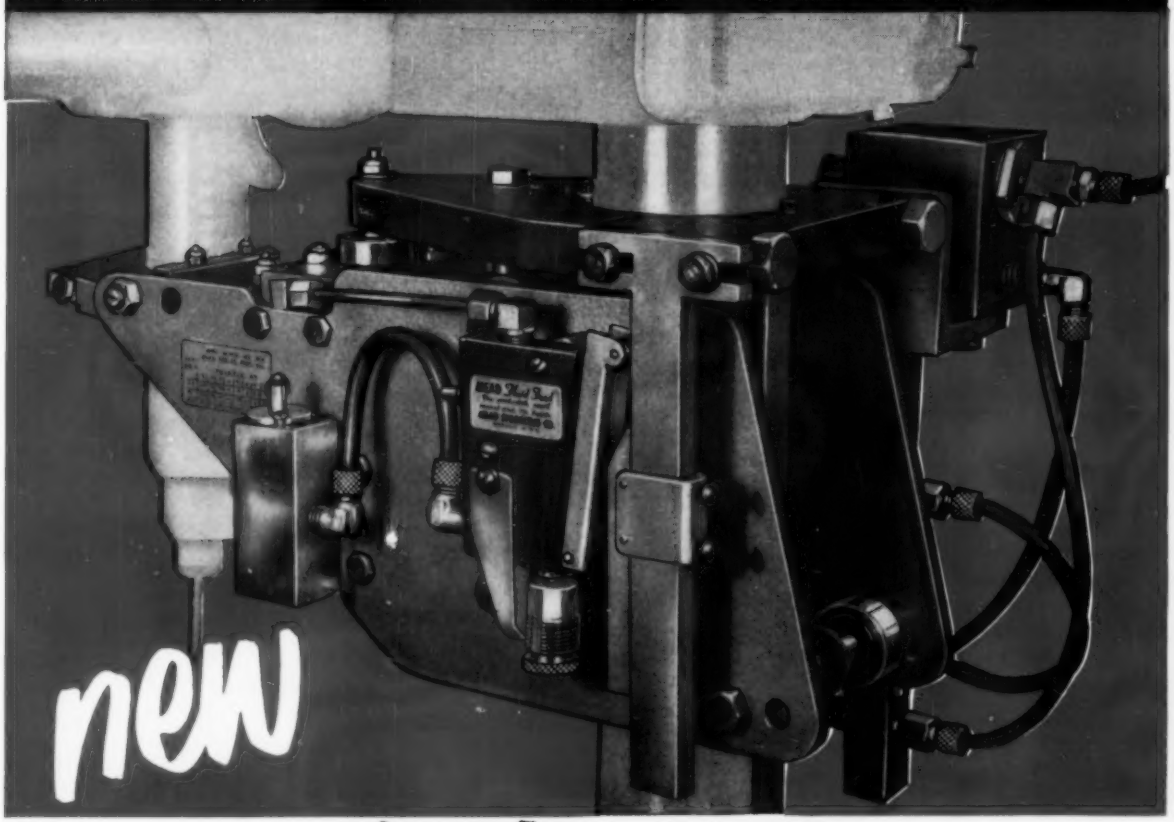
Jim Grimstad: We have seen a fair increase in the use of fluid motors on applications previously powered by explosion-proof electrical motors and on applications previously mechanically driven through clutches for interrupted motions. There has been a general tendency to switch over to fire-resistant fluids on die casting machines, furnaces and to a lesser extent on large resistance welders.

There has been a general trend toward more fully automatic operation but to a greater extent on machinery which is being manufactured for shipment than on equipment being used in the area. The automatic automotive frame plant, A. O. Smith Corporation, was the grandfather of automation. A new brass rolling mill at American Brass in Kenosha is almost completely mechanized. American Motors' automobile plant, in Kenosha, have transfer machines; and in the aluminum utensil industry there are many completely mechanized machines utilized in their line production operations.

• **WHAT DO YOU THINK IS NEEDED TO INCREASE THE USE OF FLUID POWER?**

Ad Smith: The fluid power industry is new. On the whole it has done little in the way of sales pro-

Fluid Feed AIR-HYDRAULIC DRILL PRESS FEED!



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EXCLUSIVE NEW OIL-FLOW PRINCIPLE ADJUSTS RATE OF FEED ACCURATELY FROM 2 INCHES TO 60 INCHES PER MINUTE... Combines Even Steady Hydraulic Feed with Economical, Dependable Air Power!

Learn how Mead's exclusive new oil-flow principle provides pre-selection of feed speed accurately from 2 to 60 inches per minute yet is adjustable during operation — how the usual needle valve and air bubble troubles are eliminated—how steady, even hydraulic control combines with economical, dependable air power to give faster, easier, better production.

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It will pay you to write factory or nearest Mead Representative (listed in Thomas' Register) for special 4-page folder plus Catalog of other Mead units suitable for automation with this remarkable new Fluid Feed Air-Hydraulic Drill Press Feed! Write now!

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motion. It appears that manufacturers have felt that by producing usable equipment, they have fulfilled their function. Consumer goods manufacturers have learned, long ago, that instructions are a must. Even hardware items costing $1.50 come with parts drawings and installation instructions. When the fluid power component manufacturer develops material which suggest applications for his product and gives detailed instructions as to how the installation should be made, the fluid power industry will go ahead in giant steps.

Bob Lancaster: There is a demand for more reliability and dependability in pumps, cylinders, valves and accessories. Service, where necessary, must be facilitated. Emphasis in our area is on quality. Circuit design must aim for simplicity and trouble-free service.

Jim Grimstad: Users want higher efficiency from pumps and motors. They would also like to have servo controls incorporated in fluid power drives for a reasonable cost. As in the past, a substantial part of new markets for fluid power equipment will be on machine operations which are presently controlled manually or with full electrical systems. To develop these new markets, I would say, the most important factor is increased personnel, particularly at the maintenance level, so that hydraulically operated machines can be kept running by plant mechanics. We, of course, also always feel the need for increased amount of capable sales and service engineers. Obviously the hydraulic manufacturers need increased personnel to accomodate the comparatively rapid increase in hydraulic and pneumatic volume. Secondly, new components are always in demand and are being rapidly produced at the present time as developments occur.

Ralph Moss: I agree with Ad Smith that more sales promotion is needed. Part of this sales promotion is going to come automatically by the increased uses of hydraulic systems on passenger cars and buses. However, more promotional work could be done to present the use of fluid power in a simplified form so that small shops will not consider it a new fangled idea but will actually accept it as being a better means of producing work. This promotion is going to have to be backed up by increased reliability. In the past, we have all had the experience of selling a new user on the idea of trying hydraulics or pneumatics and when the component items caused early difficulty it killed the idea in this customer's mind that fluid power is here to stay. ▼▼▼

Note to reader: What do you need to help you increase the use of air and hydraulics in your plant or on the machines you design?

Get CONSTANT airflow at the CONSTANT pressure you need

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P3-4-15E 3	3"	1-1/8"	4	9¾"	External	1500	10,500 LBS.	$34.25
P3-6-15E	3"	1-1/8"	6"	11¾"	"	1500	"	36.75
P3-8-15E	3"	1-1/8"	8"	13¾"	"	1500	"	39.50
P3-12-15E	3"	1-1/8"	12"	17¾"	"	1500	"	44.75
P4-5-15E	4"	1-1/8"	5"	10¾"	"	1500	18,750 LBS.	39.50
P4-6-15E	4"	1-1/8"	6"	11¾"	"	1500	"	41.50
P4-8-15E	4"	1-1/8"	8"	13¾"	"	1500	"	45.75
P4-10-15E	4"	1-1/8"	10"	15¾"	"	1500	"	50.00
P4-12-15E	4"	1-1/8"	12"	17¾"	"	1500	"	54.00
P4-5-30E	4"	1-1/2"	5"	10¾"	"	3000	37,500 LBS.	55.25
P4-6-30E	4"	1-1/2"	6"	11¾"	"	3000	"	57.25
P4-8-30E	4"	1-1/2"	8"	13¾"	"	3000	"	61.50
P4-10-30E	4"	1-1/2"	10	15¾	"	3000	"	65.75
P4-12-30E	4"	1-1/2"	12"	17¾"	"	3000	"	69.75
INSERTED CAP TYPE								
P3-4-15-1	3"	1-1/8"	4"	11½"	Inserted	1500	10,500 LBS.	34.25
P3-8-15-1	3"	1-1/8"	8"	17½"	"	1500	"	39.50
P5-12-30-1	5"	2"	12"	21½"	"	3000	59,250 LBS.	85.00
P5-18-30-1	5"	2"	18"	27½"	"	3000	"	97.50
P5-24-30-1	5"	2"	24"	33½"	"	3000	"	115.00
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EXTERNAL CAP TYPE

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Has built-in adjustable relief valve, set at 1000 PSI with a spring loaded neutral position. Used for controlling (1) double action cylinder of the types shown in this advertisement. Can also be mounted in series. Has 3/4" standard pipe inlet & outlet ports. 1/2" pipe thread cylinder port. Shipping weight 10-1/2 pounds. . . . . **21.50 NEW**

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A rugged, heavy duty cylinder. All steel construction. Double action. Has 7" bore. 13" stroke. 2½" steel shaft. Ideal for use in hydraulic presses, leveling ramps, hydraulic tail gates, industrial machinery, road machinery, etc. Shipping weight 180 pounds. . . **95.00**

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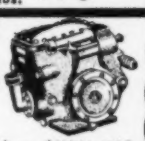
Same as above except has 8" bore, 15" stroke. Will give 50000 lbs. thrust at 1000 PSI. Shipping weight 185 lbs. **105.00**

VICKERS AA20328 HIGH PRES. PUMP



Automatic, variable volume of 1850 to 2000 PSI continuous operating pressure. Has a continuous speed of 3750 RPM maximum. Displacement is .600 cu. in per rev. Will deliver up to 9.2 gallons per min. at 3750 RPM. Rotates right hand only. Will operate in any position, but top case drain must be connected to reservoir. Reservoir must be pressurized. Ports are 1" AN inlet and 5/8" AN outlet. . . . . **ONLY 129.00**

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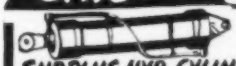

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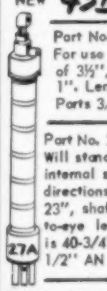
Gov't Surplus Bargain. Produces up to 40,000 lb. thrust with a 3000 PSI line pressure. May also be used as a low pressure air system cylinder. Has a 4" bore, 18" stroke, 30½" length. Part No. 29. New & Used.

NEW **43.95** USED **29.95**



Part No. 27A. Finest Surplus. For use up to 1500 PSI. Has bore of 3½", stroke 21-5/8", shaft 1". Length 29¾". Ports 3/8" AN pipe. **35.77**

Part No. 27B. Similar to above. Will stand up to 2000 PSI. Has internal stroke cushion in both directions. Bore 3-7/8", stroke 23", shaft 1-3/8", eye-to-eye length closed is 40-3/4". Ports are 1/2" AN pipe. **45.00**

Part No. 27C – Similar to 27A above. Take up to 1500 PSI. Has 3-1/2" bore, 23" stroke, 1-1/2" shaft, 34" closed lgth. 1/2" AN pipe ports. **45.00**

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For use where tremendous power at a low take-off RPM is desired. Has 6 gears rotating on self-lubricating, hi-speed roller bearings. 85 to 1 gear ratio. Shafts are 1/4" and 3/8" in diameter. USED . **5.95** NEW – in excellent condition. **8.95**

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Thrust shaft is in two stages. First stage extends 39" – the second stage extends 18". Each stage works seperately. The overall length eye-to-eye is 61½". Inner shaft is 2-3/4" dia. outer shaft is 3¼" dia. Bore is 4¼". Ports are 1/2" AN pipe. **165.00**

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For use with a short stroke press or as a static pressure booster pump. Reservoir mounts vertically with a capacity of 45 cu. inches. Has two position handle. . .

HYDRAULIC HAND PUMP – Has 1500 PSI operating pressure. 1.5 cu. inch capacity per complete cycle. Top condition. **12.75**

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HOW TO USE SELF-SEALING COUPLINGS

Both the designer and the service personnel must rely on quick disconnect self-sealing couplings for proper functioning of an increasing number of flight control and utility systems in aircraft. A top authority reviews design and performance characteristics.

• By Robert J. Dawson

ON military aircraft easy and quick removal of basic airplane components is a must. Where hydraulic lines bridge these components, hydraulic self-sealing couplings are used to provide removal and replacement of such components with minimum loss of hydraulic fluid and minimum inclusion of air.

Present airplanes involve complex hydraulic systems with each portion of the system dependent upon the next for satisfactory operation. The hydraulic disconnect couplings play an extremely important part of this requirement.

A self-sealing hydraulic coupling may be broken down as two coupling halves, each containing its own self-sealing poppet with a mechanical locking means to mate and lock the two halves, open the poppets and be self sustaining to hydraulic separation loads as well as vibration loads imposed on the airplane. Each coupling half becomes a check valve when the coupling is disconnected, preventing loss of hydraulic fluid.

One of the latest production fighter aircraft planes uses seventeen complete couplings and six coupling halves as airborne equipment. These are shown in Figure 1. Due to the complexity of modern jet aircraft and the necessary compact design, these couplings by necessity, are often located in relatively inaccessible areas.

Couplings are usually required between the engine driven hydraulic pumps and the adjacent airplane structure. Normally three disconnect couplings are necessary at each pump for suction, pressure and pump by-pass lines. Failure or malfunction of any one of these couplings would cause the loss of that system and possible damage to the pump.

ROBERT J. DAWSON, *Senior Hydraulic Design Engineer, North American Aviation, Inc., Los Angeles, California*

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SELF-SEALING COUPLINGS

AVIATION

In aircraft, where the engine is contained within the fuselage it is sometimes necessary to remove or separate the forward and rear fuselage halves to remove and replace or service the engine. Hydraulic units, wherever practical, are located in the forward section so that hydraulic lines do not have to bridge the break point. However, hydraulically powered flight control actuators are by necessity located adjacent to control surfaces in the rear section, requiring hydraulic disconnect couplings at the fuselage break.

The basic flight control diagram shown in Figure 1 is a full power, dual simultaneous system. Power is being supplied simultaneously by two seperate hydraulic engine pumps, each supplying half the necessary flow and pressure for maximum rate and hinge movement. The power loss of one system still permits control of the airplane at reduced rate and hinge movement, through the other system.

Failure or poor connection of the coupling on either system return line causing a blocked return flow would create a fluid lock on the actuator, making the surface immovable, unless adequate system design provisions are made to compensate for a coupling failure.

Self-sealing couplings are also used in the brake

COUPLING SERVICE PROBLEMS

1. Failure of the coupling halves to properly mate, allowing the couplings to inadvertently become uncoupled or not properly coupled on initial installation.

2. Failure of the coupling self-sealing poppets to open or partially open, causing excessive pressure drop or a blocked line.

3. Failure of locking device, causing inadvertent uncoupling under vibration or pressure surge.

4. External leakage with the couplings coupled or uncoupled.

5. Failure of ground personnel to properly assemble, allowing couplings to work properly for a period and then fail to function as intended.

6. Stripping of threads where they are used as the locking device between coupling halves.

7. General lack of uniformity, tolerances, spring rates, poppets or locking device, surface finish, causing excessive seal wear.

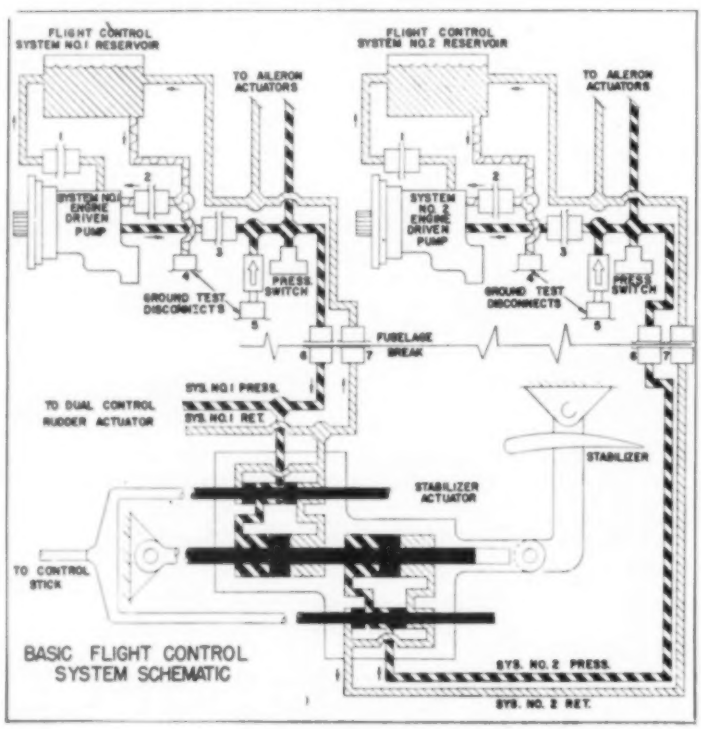


FIG. 1. A basic hydraulic flight control system schematic showing location of airborne self-sealing hydraulic disconnect couplings: pump by-pass (1) pump suction (2); pump pressure (3); pump suction, test stand connection (4); pump pressure, test stand connection (5); system pressure fuselage break (6); and system return fuselage break (7).

lines, usually adjecent to the wheels. These couplings serve as the break point for the hydraulic lines to facilitate wheel and brake removal.

Couplings are required for ground servicing and tests. These couplings are usually located in a group so that service and testing may be accomplished without movement of the test equipment. Couplings are normally provided for each system so that servicing and check out of each system may be made.

INSTALLATION

Usually two or more couplings are located adjacent to one another in the airplane; often this may create a problem where the couplings may be of the same line size and type. Since the socket half of the coupling must attach to a flexible hose, careful design of installations is necessary to prevent crossing of lines and systems. This may be accomplished by arrangement of the couplings and their respective hoses. The coupling halves should be located so that the respective hose lengths will not allow cross connection. This arrangement, although adequate at the time of original installation, does not prevent replacement hoses of a different length being cross connected in service. It is usually considered better design to use couplings of a different manufacture which will not mate so that cross connections cannot be made.

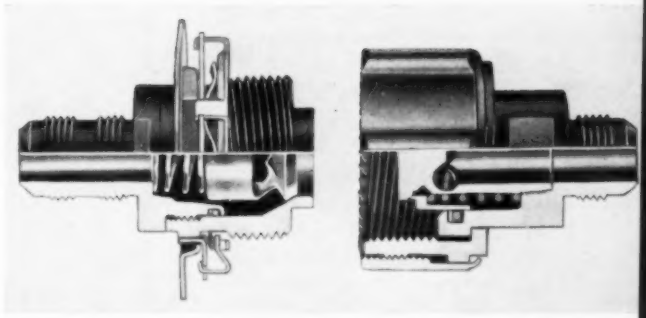
Adequate space in the aircraft should be provided for coupling and uncoupling without the use of tools. The coupling should be so located that it may be visually inspected for proper connection and maintenance whenever possible.

DESIGN

There are many hydraulic self-sealing couplings available to the installation engineer; however, great care should be taken in choosing a specific coupling for aircraft use.

Figures 2, 3, 4 give details of three representative hydraulic couplings now in use on aircraft hydraulic systems. A number of other couplings of these general types are available.

The coupling should be designed so that positive



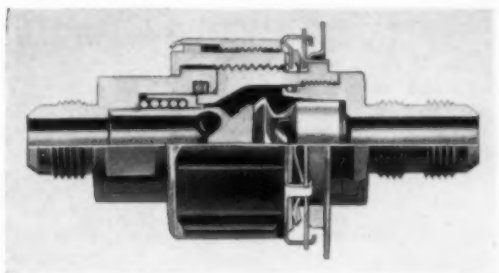


FIG. 2. Cross section views of both connected and disconnected couplings. The left half, in the disconnected view, shows a tubular valve and sleeve; the sleeve is held against the head of the valve by a spring; an "O" ring provides a seal between the sleeve and body. The right half is a male body in which a poppet valve is held against its seat by spring pressure.

Courtesy Aeroquip Corporation

FIG. 3. Two types of hydraulic couplings that utilize the basic dog design are shown. Coupling at left employs a poppet type valve and incorporates secondary locking through the use of a bayonet lock on the coupler ring. Coupling at right has a flush valve. Secondary locking by either latching mechanisms or a bayonet lock is optional.

Courtesy E. B. Wiggins Oil Tool Co., Inc.

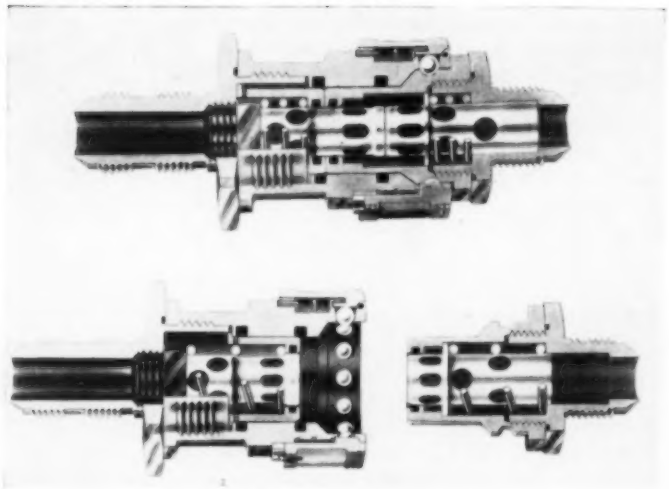


FIG. 4. Connected and disconnected cross sections of a new design aircraft and missile coupling with identical valves in both coupler and nipple halves. When connected the force of both springs hold the faces of the valves together; four "O" rings, arranged in pairs on the inside and outside sleeve surfaces, provide positive sealing.

Courtesy Snap-Tite, Inc.

action of the self-sealing poppets takes place when the coupling is coupled or uncoupled. The valves or poppets should have enough guide to insure against misalignment. They should also be provided with a positive stop so that flow through the coupling in either direction will not close or tend to close the valves and shut off flow or increase pressure drop.

Standard MS packings should be used throughout the unit wherever possible. Replaceable special seals present an increased handling and stocking problem in the field. Special tools required for assembly of the coupling components should be avoided wherever possible.

All component parts of the coupling should be suitably safetied or locked. Torquing component parts to a specified value depending on the thread pre-load is not considered good practice, since the torque value cannot be readily ascertained by visual inspection.

NEEDS SIMPLE, FOOL-PROOF LOCK

The most important feature of any quick-disconnect coupling is the coupling or locking device. Many methods such as threads, balls, dogs and cams are presently in use. The locking feature is not only important from a mechanical standpoint, but also from a psychological approach.

In order to retain the basic function of an easy and quick method of breaking a fluid carrying line, the locking device must be simple and fool proof. There should be only two positions of the coupling —coupled and uncouped— with no intermediate position. The coupling should readily indicate a proper and safe connection. If it is possible to assemble the coupling to partially open the poppets and still not have the coupling or locking device properly engaged, a hazard to the airplane and its crew would exist. An ideal locking device would be one that opened the poppets only when a positive connection is accomplished.

Since hydraulic couplings are used on removable components and are at times subject to other than ideal storage conditions while installed on such components, adequate thought must be given during selection as to the effect of dirt and contamination and its influence on the locking device and primary seals. When portions of the locking device mechanism may be exposed to dirt and other contamination in either the coupled or the uncoupled condition, the locking mechanism could be jammed or made unusually hard to operate, necessitating possible rework or replacement.

PREVENT TROUBLE FROM DIRT

When sealing areas are exposed during uncouple periods it is necessary that ground personnel wipe these surfaces to prevent damage to the primary seals. Cavities should be avoided where dirt or other foreign matter could collect and be introduced into the system on re-assembly of the coupling halves. Caps or closures are usually available to protect the internal surfaces when the couplings are disconnected. However, in the field these caps or closures are not always readily available.

Selection of material used in the manufacture of any hydraulic disconnect is important. The material should not only be suitable to withstand the structural loads imposed and suitable from a corrosion standpoint but also able to withstand abuse, a factor not considered in other components. The socket half being connected to a flex hose may be struck on airframe structures by the mechanic during disassembly, or inadvertently contacted by maintenance personnel while uncoupled. It would be advantageous if the coupling design did not expose surfaces which pass or contact seals when mated. ▼▼▼

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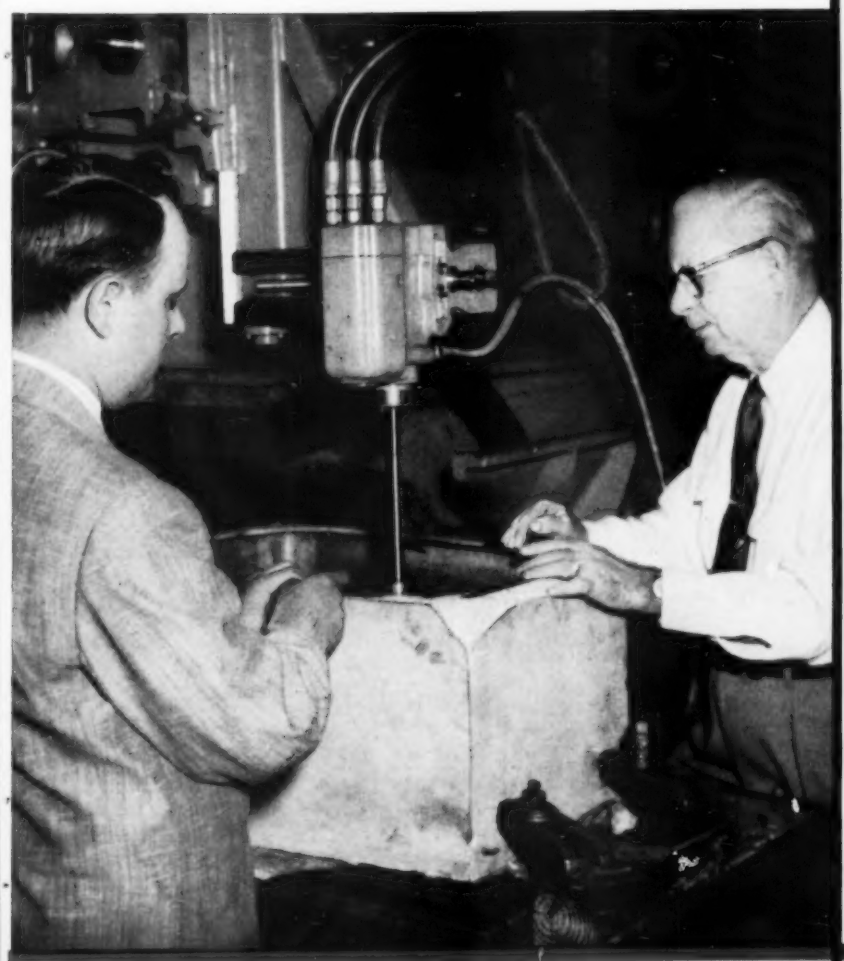

A. T. Wallace (right), President of Wallace Tool and Die Company, and Standard Oil lubrication specialist, H. A. Peterson, check sensitivity of new Cincinnati Hydro-Tel Milling Machine which uses STANOIL as hydraulic medium. Howard Peterson has been providing technical service to customers since joining Standard Oil. He is a graduate of General Motors Institute. Howard's customers find this experience pays off *for them.*

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Ideas from a Sales Engineer

Elmer F. Heiser

Elmer Heiser has been selling air and hydraulic components for 19 years. During this time he has solved many problems and admits to leaving some unsolved. He is the author of the book "Air and Oil Cylinders in Industrial Applications."

Making An Air Cylinder Behave

THIS column will be different—so different from preceding columns that it may come out like one more article in the magazine, which could be refreshing. In the book, "Air and Oil Cylinders in Industrial Applications", which is frequently mentioned at the top of this column, I have attempted to point out many of the problems encountered in air cylinder applications. The use of air cylinders on jobs where there is a definite change in work resistance during the stroke is discussed but specific examples are limited. Here's a job which turned up recently that provides such a good example of one of the points covered in the book, it seems a good idea to bust through it in this column.

We got mixed up in this deal after it was under way and it was advisable to retain as much of the initial design as possible. The use of air for the purpose might be questioned; however, hydraulic power was ruled out for a couple of good reasons. The first, because the design was well along based on the use of air, and secondly because the speed, pressure, volume requirements complicated the hydraulic picture. It would mean scrapping most of what had been placed on paper to accomplish the operation with any efficient hydraulic system.

Sketch 1 indicates the basic problem. A and B are conveyor lines approximately 10'-0" apart. There is a transfer unit pivoted midway between the two conveyors which picks up parts from A, swings them through an arc of 180° and deposits them inverted on conveyor B. The loads to be transferred vary from 300 pounds to 500 pounds and the transfer return from B back to A is light,

Sketch 1

empty or without any load. One more condition added interest to the problem. The time allowed for a complete cycle of transfer and return, ready for another load was 10 seconds. This meant that with some reasonable allowance for acceleration and deceleration, the 5'-0" long arm and the 500 lbs. maximum load must be traveling at an uncomfortable speed somewhere along the line to complete the cycle in the required time.

When we came into the picture, a preliminary arrangement as in sketch 2 had been worked out. By way of explanation the 180° rotation of the main shaft was reduced to 90° through a 2 to 1 gear. An arm was keyed to the large gear shaft and a large bore, cushioned type air cylinder was indicated

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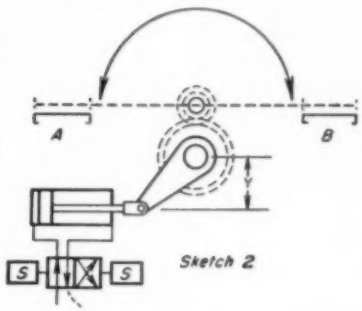
for powering the movement. The air cylinder was to be controlled by a large two position 4-way air valve.

There is no question that an air cylinder of sufficient area with a



Sketch 2

control valve of ample size could move the maximum load through the 180° travel in the required time. It was evident though that there could be some question as to what would happen when the first load, transferred the first time, reached its destination. Obviously maximum force at the cylinder would be required to start the load initially. At this point the torque at the main shaft is maximum with load at A while the effective lever arm of the cylinder is reduced to its minimum as at Y.

It's a Runaway Load

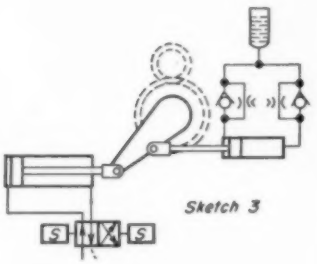
When the 4-way valve is shifted and pressure is admitted to the large cylinder to start the transfer cycle nothing can happen until the opposite side of the cylinder is exhausted to a sufficiently low pressure to allow line pressure to overcome the load. At the time the load starts to move, full line pressure will be on one side of the cylinder with little or no pressure on the opposite side. However, as the load moves, the force required diminishes due to the arc, and at the top of the swing zero force is required. Once the load moves past center, gravity assists the transfer motion. It can be seen that a condition results where gravity is added to the problem of the expanding air within the cylinder. When it is realized that there will be a negligible back pressure for cushioning on the ex-

hausting side of the cylinder, it becomes obvious that stopping the downhill, run-away load can be a problem.

In order to obtain the necessary control and retain the air powered equipment already designed we added an oil cylinder to the system as shown in sketch 3.

Adds Hydraulic Control

The oil cylinder is provided with long tapered cushions, and speed control valves, as indicated, are included to control the maximum speed. With this arrangement we did manage to move the variable loads at high speed and yet check or snub the movement at each end to eliminate shock.



Sketch 3

Along about here in the progress of the job we became conscious of the hind-sight and fore-sight factors in the job. Foresight hopped right on the obvious necessity of controlling the maximum speed and the deceleration but overlooked some minor problems. We realized immediately that one shot with the air cylinder alone, operating the transfer, could instantly create a major problem, part of which could involve searching the floor below for some of the pieces. Recognition of the major problem and the pursuit of a suitable answer over-shadowed any minor problems in the picture. Real foresight would have pointed out the minor as well as the major problems but at least we had some equipment left, after initial tests with which to second-guess.

Air Was Wasted

One secondary problem was the apparent waste of air at pressure to drive the load downhill from the high point of the arc. Another secondary problem was the time

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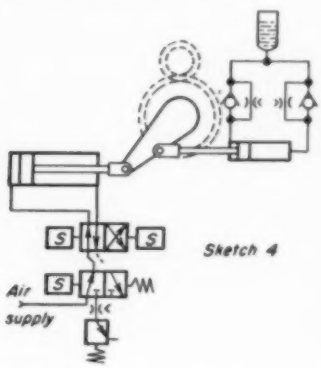
lag resulting at the start of each transfer stroke. With the two position 4-way valve we were holding the transfer arm down in position with high pressure air at each end of the stroke. Before the upward motion of the transfer could start in either direction, the large volume of air at pressure had to be exhausted. This exhausting, to drop the backpressure, resulted in a delay of perhaps one second at each end of the cycle. This meant that the rate of speed during transfer had to be increased considerably to permit completing the cycle in 10 seconds.

Sketch 4 shows the control change or addition to correct the two minor problems. Note that a solenoid operated 3-way air valve is placed in the line ahead of the 4-way with a relief valve and a variable orifice on the 3-way exhaust. The 3-way, in its normally de-energized position, blocks the supply line and connects the 4-way to exhaust through the relief valve.

The Problem's Whipped

To start the cycle, the 3-way is energized whenever the 4-way is shifted. At a point near the top of the swing, the 3-way is de-energized, cutting off any additional supply of air. The air in the cylinder expands to carry the transfer over center and start it down the hill. Simultaneously, air in the cylinder is allowed to exhaust at a controlled rate through the 3-way exhaust port. It can be seen that the effect of the trapped air



Sketch 4

in the cylinder on the downward speed of the transfer can be diminished as required. The relief is set at low pressure to assure a complete movement independent of gravity, should any undue friction occur.

The final arrangement, with foresight and hind-sight working out the problems, makes it possible to get maximum force from the air cylinder at the start of each stroke and it permits reducing the force at a controlled rate as the load shifts. Also gravity only holds the transfer down. Further, the cylinder is almost completely exhausted so there is no delay in starting. The cycling meets the ten second requirement with no shock at deceleration and consumes less than 50 percent of the compressed air required for the original hook-up.

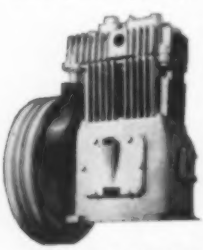
Did this read like our usual column? Notice no dogs, fish or peddlers were mentioned? Pretty dull, huh? ▼▼▼

Sawing caps off forged aluminum connecting rods. A screw feed was replaced by pneumatic cylinders for both feed and traverse. The fixture was redesigned for a pneumatic work holding clamp. Result: a Quincy Compressor, three air cylinders and a new fixture increased production by 15%!

15% PRODUCTION INCREASE with QUINCY compressed air

Just another example of how compressed air can increase the efficiency of production equipment. And compressed air can save in many other ways . . . operate clutches and chucks . . . remove metal cuttings . . . operate hand tools, hoists and precision gages. It's especially suitable for increased automation of older equipment.

When you think of using compressed air, remember Quincy Compressors. They give you greater dependability, increased efficiency and longer life. Features like loadless starting and safe-Q-lube put Quincys ahead of all others.



For complete details on how this application was made, write Dept. AH-456 today. Also ask for Form 300 on industrial compressors. 21 models from 1 to 90 C. F. M.

Quincy COMPRESSORS

QUINCY COMPRESSOR CO. • QUINCY, ILLINOIS

Circle 85 on Reader Service Card

Circle 117

Filter, regulate, and lubricate the air
used for air-operated tools and equipment.
Watts combination filter-regulator-lubricator has a . . .

Scientifically designed filter which traps
condensation, pipe scale, and dirt from the air . . .

Regulator which precisely maintains the air pressure
at the desired pressure setting . . .

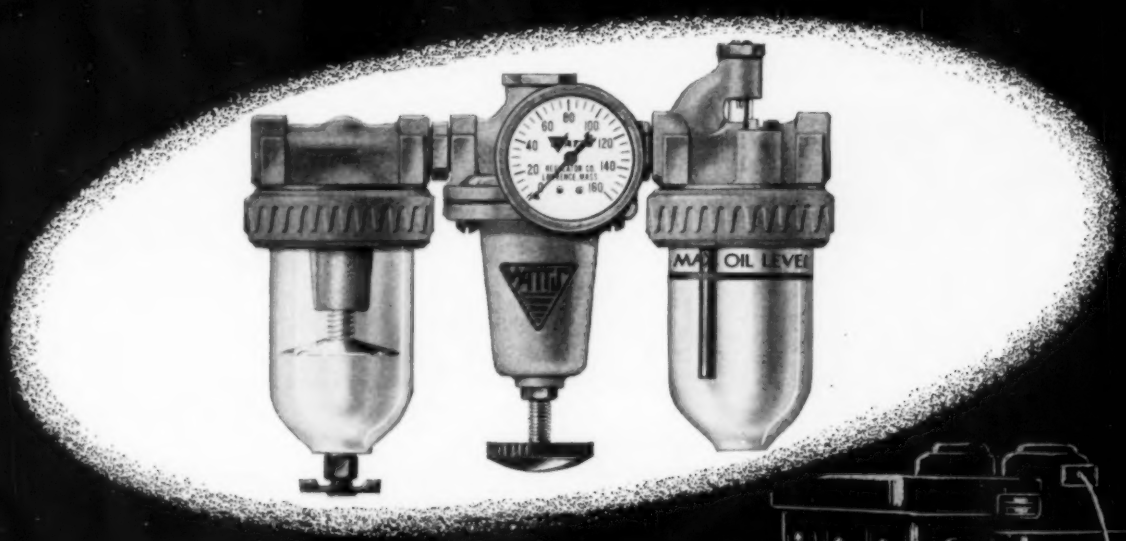
A lubricator which provides
the correct degree of vaporization of the oil
to minimize wear and friction of air-operated equipment.

For complete specifications
on this new line of products, write to . .

WATTS INDUSTRIAL DIVISION

of WATTS REGULATOR COMPANY
LAWRENCE, MASSACHUSETTS

PNEUMATIC PRODUCTS



For Air FILTRATION
REGULATION
LUBRICATION
as you want it!

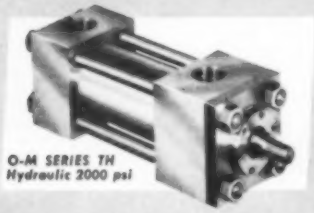
ORTMAN-MILLER Cylinders

- Air and Hydraulic
- Meet JIC Standards

O-M TIE-RODLESS
Air to 500 psi
Hydraulic to 1500 psi

O-M Tie-Rodless (air-hydraulic) with compact space-saving design due to O-M Special Interlocking Mechanism, eliminates bulk . . . saves up to ⅓ installation space. Interlocking feature also makes it easy to orient ports, disassemble, inspect, clean, repair, assemble, thus reducing maintenance.

Available in complete range of sizes (1½" to 8" bores), with standard 2 to 1 or oversize rods. All steel construction with bearing bronze. Completely interchangeable parts and mounts, as described in Bulletin No. 101A.



O-M SERIES TH
Hydraulic 2000 psi

O-M Series TH—heavy duty hydraulic type rated at 2000 psi—features heavy walled seamless steel tubing and rolled steel heads accurately machined and recessed to confine the tube and prevent breathing. A multiple lip self-compensating rod gland packing, contained in a removable cartridge, facilitates replacement.

Available from 1½" to 8" bores as described in Bulletin No. 105.

Engineering Service—

Consult an Ortman-Miller representative regarding your pneumatic and hydraulic problems. His broad experience with standard and special cylinder applications is available to you without cost or obligation. Use convenient coupon for name and address of O-M representative nearest you.

Mail coupon today for Bulletins 101A and 105

ORTMAN-MILLER MACHINE CO.

1143rd Street, Hammond, Ind.

☐ Have representative call
☐ Send Bulletins 101A and 105

Name_____ Position_____

Company_____

Address_____

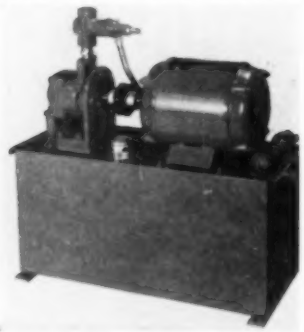
City_____ Zone____ State_____

New Products continued

POWER UNIT
. . . replaces air compressor

Designation: PT-10

Application: By taking advantage of fact that most air components can handle oil as well as air, and under greater pressures, the power of air circuits can be increased by use of hydraulic power unit instead of air compressor.



Design: Unit comprises complete equipment for 500 psi power and consists of an electric motor to 1 hp, vane type pump, rated at 3, 6, 9, or 12 gpm at 1000 psi and a relief valve. Components are mounted on a JIC 10-gallon reservoir complete with breather, filler cap and screen, oil level gage, and baffles.

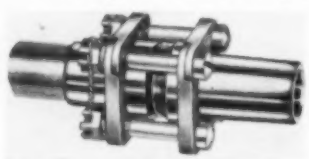
The Rosaen Co.
St. Clair Shores, Mich.

Circle 133 on Reader Service Card

TUBING CONNECTOR
. . . stays tight

Designation: Split-flange

Features: Connector is unaffected by twisting and turning of tubing and has compact design which permits installation or removal in a restricted space.



Design: For joining flared-end tubing to a tapered shoulder, connector consists of a pair of split flanges, one sleeve with a shoulder, and four bolts, nuts, and lock washers. Split flanges are locked (one on the tapered end part and one on the flared end tubing) and are tightened by the four bolts. Wire lock may be used for applications with extreme vibration.

Barco Manufacturing Co.
Barrington, Illinois

Circle 134 on Reader Service Card

1-INCH SOLENOID VALVE
. . . for 3000 psi

Designation: Type SS, Type HPSS

Design: 2-way globe type valve is pilot operated and has packless construction. It is normally-closed but can be made normally-open for pressures to 300 psi, and with the use of a relay to 3000 psi. Type SS has a standard coil for operation to 300 psi and Type HPSS has a high pull coil for applications to 1500 psi. For pressures over 1500 psi a double-wound coil and relay are required.

Features: Valve has high corrosive resistance, as all parts coming in contact with the medium are stainless steel. Full porte construction allows maximum flow at maximum rated pressure. Unbreakable piston rings assure stick-free operation, and glasswound silicone impregnated coils permit operation at elevated temperatures. Explosion-proof housing is for hazardous locations, and simple construction gives long, trouble-free life.

Atkomatic Valve Co., Inc.
Indianapolis, Ind.

Circle 135 on Reader Service Card

HIGH PRESSURE REGULATOR
. . . has internal filter

Features: Manually operated high pressure regulator has greaetr sensitivity and wide adustment range. Valve is for maximum inlet pres-

Continued on page 106

Circle 104 on Reader Service Card

If your equipment or process requires . . .

ACCURATE, AUTOMATIC TEMPERATURE CONTROL

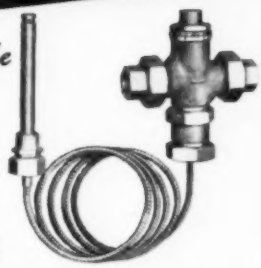
for HEATING or COOLING (using STEAM, WATER, or HEAT TRANSFER FLUIDS)

There is no equal to the

Sterlco®

Series 150-E

TEMPERATURE CONTROL VALVE

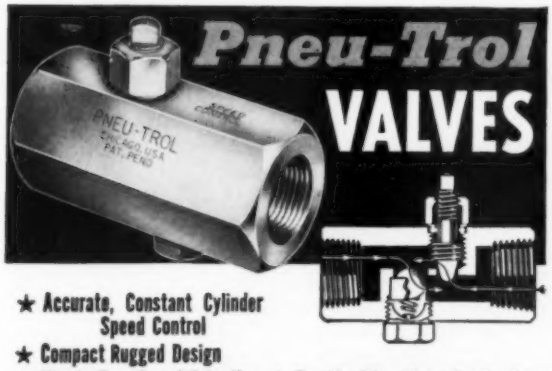


Here is a quality, dependable, and low cost self-actuated automatic modulating control valve. It's compact, self-contained; and, as part of your equipment or process, will eliminate the human factor of manual valves. Balanced single-seated construction eliminates effect of pressure variation. Send for Bulletin #505.

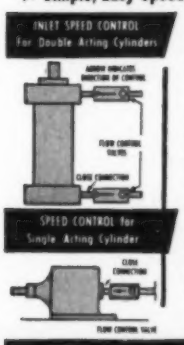
MOUNTS *and* OPERATES *in* ANY POSITION

INDUSTRIAL CONTROL DIVISION
STERLING, INC.
3742 N. Holton Street • Milwaukee 12, Wis.

Pneu-Trol VALVES



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications



Pneu-Trol Speed Control Valves, are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

Pneu-Trol DEVICES, INC.
1426 N. KEATING AVENUE • CHICAGO 51, ILL.

Linear YJ-70

when conventional packing will not do

Conversion from flammable to non-flammable fluids has created serious packing problems in many hydraulic systems. Ordinary molded seals deteriorate rapidly when non-inflammable fluids are used in the system.

Pioneer research by LINEAR has developed Compound YJ-70 to solve this problem. YJ-70 is not affected by *Skydrol, Pydraul, Lindol* or mediums that contain *Tri-Cresyl-Phosphate*—provides perfect sealing in systems using these and other diester fluids. At the same time, YJ-70 withstands deterioration and maintains dimensional stability in the usual flammable petroleum base fluids.

This dual compatibility makes packing change over unnecessary . . . no down time for packing replacement . . . assures perfect sealing under all conditions.

Here is another example of LINEAR leadership. Whatever your packing problem, it will pay you to look to LINEAR.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.

 Circle 83 on Reader Service Card

Circle 64 on Reader Service Card

New Products continued

sure of 4500 psi. Internal relief valve and filter are removable without disturbing spring and diaphragm structure, and unit has adjustable mounting brackets. Lower rate springs increase flow sensitivity and internal stops protect against abuse to inter-valve structure of the regulator, line failures, and misapplication of pressures. Models are available for high pressure, high sensitivity relief and back pressure service.

Accessory Products Corp.
Whittier, California

Circle 136 on Reader Service Card

3-WAY SELECTOR VALVES . . . 85% higher flow

Designation: Series 6000, 6050

Features: Series 6000 valves for ¼ and ⅜-inch tubing handle up to 6 gpm compared to 3.2 gpm for standard ⅜-inch valves. Solenoid-operated units are characterized by compactness and light weight.

Design: Fully balanced inverse poppet permits flow to be reversed between any two open ports without disturbing the flow or operating characteristics of the valve. Design ensures perfect alignment with seat axis and extremely low leakage and bind-free performance. Internal configuration further minimizes dynamic effect of the flow.

Construction: Valves comply with MIL-V-5529A and have ports located to permit convenient connection of tubing and easy installation of mounting brackets. Weight of Series 6000 is 1.50 lb and weight of Series 6050 is 1.61 lb. Single-coil solenoids operate from 18 to 30 volts dc.

Aircraft Products Co.
Bridgeport, Pa.

Circle 137 on Reader Service Card

SERVO PUMP . . . delivers 55 hp.

Designation: Series PV 3918

Operation: Electro-hydraulic, aircraft type servo pump unit is essentially an electrically controlled, variable delivery unit. Direction and rate of fluid flow from servo pump unit is controlled by application of a small electrical signal to a solenoid or torque motor which is usually included as an integral part of the pump. Velocity, position, and direction of motion of the output member and the load is under control of this electrical signal and such feedback circuits as may be desired. Speed changes are smooth and stepless.

Design: Unit delivers 35 gpm at 3500 rpm and is intended for use

THE FOSTERMATIC "BULLDOG" GRIP
"Dogs" are contoured to grip 41% of plug locking surface.

FOSTERMatic QUICK DETACHABLE COUPLERS

- "Floating Carrier" holds dogs in position and absorbs vibration of pulsating air. Eliminates usual housing wear.
- Can Be Used Directly With Reciprocating Air Tools Without The Use Of Lead Hoses
- Chrome Sleeve is Stress-Proof Heat-Treated Steel. Withstands Roughest Treatment.
- Greater Air Capacity — Small Diameter — Light Weight

Here's a coupling that's suitable for 90% of all uses. Snaps on — snaps off. Delivers 49% more air. Write for new descriptive Bulletin FMC.

FOSTERMATIC "DOGS" LOCK STEEL against STEEL at 45°

FOSTER MFG. CO. Inc.
2850 Gravois 13-C
St. Louis 18, Mo.

FREE! NEW SOLENOID VALVE CATALOG

Atkomatic's completely new 1956 engineering guide . . . Catalog 200

Automatic flow control —air, gas, steam, liquids

Send for it!

Solve YOUR flow control problems Atkomatic-ly

Order from a complete line of two-way solenoid valves . . . fully illustrated and described in Atkomatic's new engineering catalog. Contains flow charts, coil charts, dimensions, applications. For economical, trouble-free operation depend on Atkomatic.

- Built to your specifications
- Individually tested
- Packless
- Tight closing
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- Rugged, dependable
- Bronze or stainless steel
- Temperatures to 450°
- High and low pressures
- ¼" to 3" full port pipe size

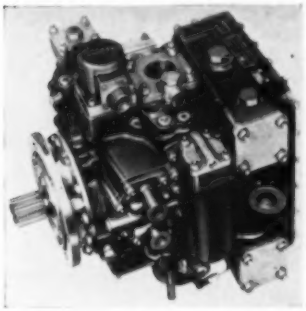
SEND TODAY FOR CATALOG 200

Atkomatic VALVE CO., INC.
DEPT. I-A, 545 W. ABBOTT ST., INDIANAPOLIS, INDIANA

Circle 39 on Reader Service Card

Circle 12 on Reader Service Card

in systems having intermittent operating pressures to 4500 psi. Principal sub-assemblies are power pump, control solenoid, control valve, stroking cylinder and piston

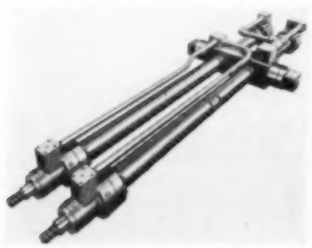


assembly, control pump, replenishing pump, yoke synchro, position limiter, pressure limiter, override mechanism and main housing. The unit is normally controlled by an electronic or magnetic amplifier.

Vickers, Inc.
Detroit, Mich.
Circle 138 on Reader Service Card

SPECIAL CYLINDERS
. . . for wind tunnel

Design: Yoke trunnion mounted cylinders are for operating model plane support carriage in a trisonic wind tunnel. Units have a 4½-inch bore and 108-inch stroke. Pistons are an integral part of the 3 3/16-inch rams and both are chrome



plated. Guides for the pistons and rams are bronze and ram wipers are in the front head. All O-rings and packings are specially designed for use with fire resistant fluid.

Performance: Cylinders have adjustable hydraulic cushions and decelerate 7600 lb of mass at 5 feet per second in 2.4 inches. Net weight of unit is 3200 lb.

The Oilgear Co.
Milwaukee, Wis.
Circle 139 on Reader Service Card

LIQUID SPRING
. . . built-in shock absorber

Designation: Liqui Spring Shok

Design: Unit incorporates an integral hydraulic levering principle

Continued on next page

HERE'S a helping hand

for your packing problems

Let our packing design specialists help you determine the right packing for each specific job. Your special needs are followed to the letter . . . and MARSH packings are built the way you need them . . . to give dependable service for a long long time.

MARSH THERMO LEATHER PACKINGS
IMPREGNATED WITH SYNTHETICS
ARE DESIGNED "RIGHT" FOR THE NEED

Quality and Dependability
Backed by ***55 Years*** *of Leadership*

CUP PACKING
A piston packing for use on cylinders and controls, low or high pressures.

U PACKING
A single-lip rod or piston packing against low to moderate high pressures.

NON-EXTRUSION OR BACK-UP WASHERS
For use with "O" rings—eliminates extruding and keeps grit and dirt away from "O" rings.

V PACKING
A multi-lip rod packing against medium or high pressures.

FLANGE PACKING
A single-lip packing against low to moderate high pressures.

CUP AND HEEL WASHER
For use against higher pressures—eliminate pinching due to too much clearance.

Engineering and Consulting Service
Ask MARSH field engineers to survey your packing needs and make recommendations.

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Circle 65 on Reader Service Card

New Products continued

which permits the development of spring forces as low as 600 lb with a 2-inch stroke as well as energy absorption as a shock absorber. Wide extremes of spring force are possible with the same components while maintaining sturdy piston members of any desired rigidity. Shock absorption feature does not require complicated or critical metering and uses the same components as the spring itself.

Specifications: Spring unit is 7⅜ in. long by 1⅜ in. diameter plus mounting stud. It delivers 8000 lb of spring force with a 1300 lb preload and a 1-inch stroke and equals the combination of two 8-inch diameter springs of 7-inch length, 1-inch diameter plus two standard automobile shock absorbers each of the same diameter as the liquid spring. Units pass all military environmental and life tests.

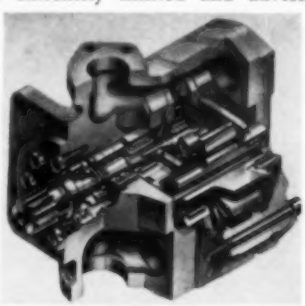
Taylor Devices Inc.
North Tonawanda, N. Y.

Circle 140 on Reader Service Card

GEAR PUMP
. . . high volume, pressure

Designation: 3600 Series

Application: Pumps are intended for heavy mobile and industrial equipment, and are especially designed for installation where space is extremely limited and adverse



condition exist. Field tests show 75-85% reduction in pump and accessory maintenance compared to similar equipment.

Specifications: Series of pumps to 150 hp, deliver 65, 90, 110 gpm at 1200 rpm. Speeds range to 2000 rpm and pressures to 1500 psi. Control valves have been developed for use with the pumps.

Hydreco Div.
New York Air Brake Co.
Cleveland, Ohio

Circle 141 on Reader Service Card

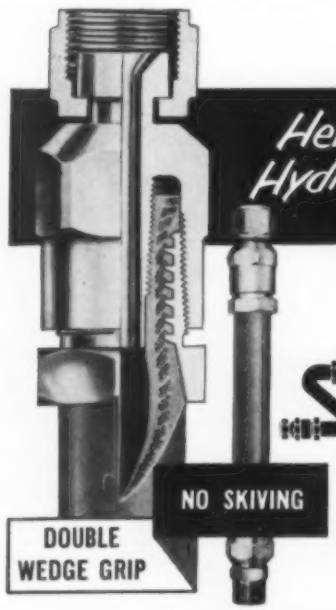
SYNTHETIC RUBBER
. . . for OS-45 fluid

Designation: Compound 66-103

Features: Synthetic rubber has been developed for use with MLO-8200 and OS-45 fluids at temperatures from −65 degrees to +400 degrees F. At 400 degrees F the compound has also been tested with a blend of 85% MLO-8200 and 15% Monoplex DOS or MIL-8515 fluid. O-rings molded from this compound are recommended for static seal applications.

Rubber Products Div.
Parker Appliance Co.
Cleveland, Ohio

Circle 142 on Reader Service Card



Here's the Answer to Hydraulic Hose Problems

JOY SURGEPRUF HYDRAULIC HOSE and RE-USABLE COUPLINGS

NO SKIVING

DOUBLE WEDGE GRIP

PERMITS THE USE OF MORE ABRASION-RESISTANT, RUBBER-COVERED HOSE

Insure longer wear in your hydraulic hose assemblies—and at the same time, save assembly time by avoiding old-fashioned skiving. Joy Surgepruf re-usable couplings make *both* advantages possible. Their exclusive "double-wedge" grip lets you use tough, abrasion-resistant, rubber-covered hose instead of the braided type—without any need for skiving the hose at the connection.

NO SPECIAL ASSEMBLY TOOLS REQUIRED

You need no mandrels or other special tools to make up Surgepruf assemblies. No extra expense or special technique is involved.

CAN BE RETIGHTENED WHEN LOOSE ON THE HOSE

Machine vibration or hose flexing can loosen any hydraulic coupling on the hose in time, but Surgepruf Couplings can be easily, quickly retightened on the job to stop a leak—*another* exclusive feature.

Surgepruf Hose Couplings are made to JIC Standards. Assemblies are available in many sizes and lengths, and in both single and double-wire reinforced types for medium-high and high pressure service respectively.

Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.

Get complete data on Surgepruf: Write for FREE Bulletin 77-19

Consult a Joy Engineer

JOY

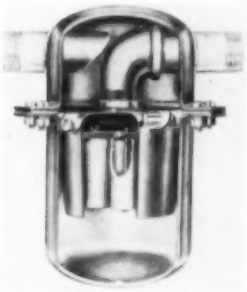
HYDRAULIC ASSEMBLIES THAT GIVE YOU MAXIMUM RELIABILITY

W&D H5518

FILTER

. . . low pressure drop

Features: Filter has permanent porous bronze, cleanable filter element for filtering out solids from 80 microns to 6.5 microns. Points



to specify in requesting information are degree of filtration, type of fluid or gas, flow required, maximum operating pressure, and pipe diameter inlet and outlet.

Arrow Tools, Inc.
Chicago, Illinois

Circle 143 on Reader Service Card

LIMIT SWITCH

. . . of small size

Design: Snap action switch measures 1⅝ x 9/32 x 7/16 inches. Fully enclosed switch is extremely compact because connecting elements in the spring release mechanism are eliminated, and there is only one moving part. With only a single stamping used, a positive snap action is provided. Force and movement are held to very close tolerances, and the blade design produces a fast snap action with positive maintenance of contact. The unit is available in four designs with operating force from 3 to 12 oz in the pin operated models and ½ to 12 grams in the wire operated models.

TyniSwitch Dept.
Detroit Controls Corp.
Bridgeport, Conn.

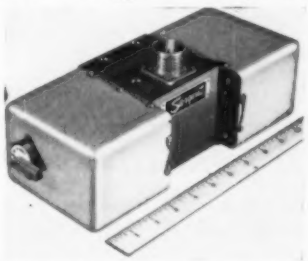
Circle 144 on Reader Service Card

ROTARY SOLENOID VALVE

. . . for missile launching system

Design: Heavy-duty valve is 2-position, solenoid controlled unit for use where extreme reliability is required. Unit is actuated by continuous-duty, long life, balanced, rotary solenoids operating on 110 V 60 cycle power. Valve is equipped with moisture-proof housings and can be left continuously energized in 165-degree F ambient. The lapped, hardened rotor and sleeve give low leakage, insensitivity to dirt, low friction and low flow forces.

Features: The valve has passed MIL-S-901 H shock test and will remain in position even if a heavy impact load is applied. Unit operates in ambient from −20 to +165 degrees F in 1500 or 3000-psi hydraulic systems. Capacity of the valve is 1.5 gpm at 200 psi total



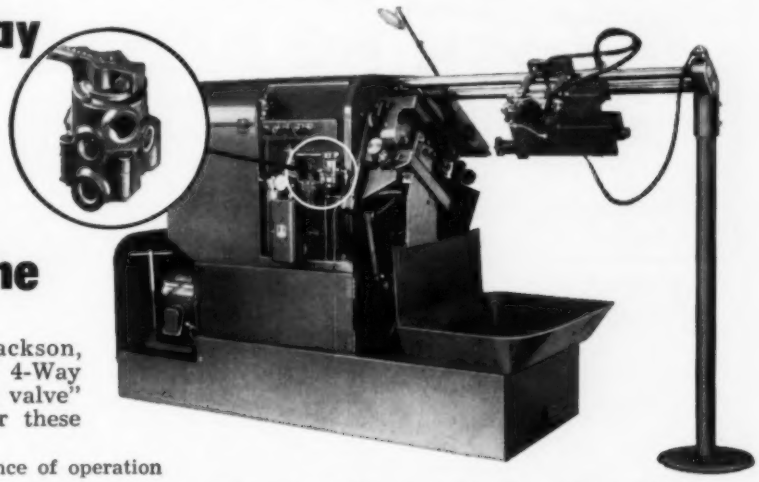
pressure drop. The maximum internal leakage is 8 cc per min at 1500 psi. All parts are corrosion resistant or corrosion protected. The valve can be used as a pilot for operating larger valves or as an independent subplate mounted unit.

Sargent Engineering Corp.
Huntington Park, Calif.

Circle 145 on Reader Service Card

Continued on next page

NOPAK Dual 4-Way is Main Air Control on "Modern" Cutting-Off Machine



Modern Machine Tool Co., Jackson, Mich., uses the NOPAK Dual 4-Way valve as the "main air control valve" on its Cutting-Off Machine for these reasons:—

1. It provides the necessary sequence of operation control.
2. It is "easily mounted . . . in readily accessible position".
3. It directs air pressure either to part of the air system, or the whole system, as required.
4. With valve lever at 45°, "the operator can set the tools, with a gauge, against the stock while it (the stock) is locked in the collet".
5. In normal running position with valve lever at 90°, air is directed to other parts of system, while maintaining pressure on collet cylinder during cutting cycle.

This application may suggest how you can use NOPAK Valves and Cylinders for effective control and application of fluid power in your product, or in your plant equipment. For other suggestions see the NOPAK Application Manual.

Write for Latest Shelf-Stock Listings

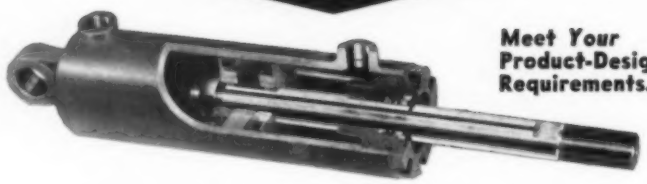
GALLAND-HENNING NOPAK DIVISION
2743 SOUTH 31ST STREET • MILWAUKEE 46, WISCONSIN

Representatives in Principal Cities

NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

Circle 20 on Reader Service Card

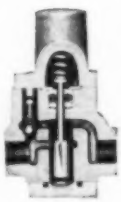
HYDRAULIC CYLINDERS
CUSTOM-DESIGNED
by B.H.E.W.



Meet Your Product-Design Requirements.

Dependable performance in minimum mounting space is characteristic of B H E W hydraulic cylinders. **Standard and special O.E.M.** designs of all types, sizes and any mounting style are available on order . . . delivered on schedule.

Send specifications of your requirements for ANY kind of hydraulic, pneumatic and water cylinder.



BHEW

Lift trucks need the B H E W Pressure-Operated Hydraulic Flow Control Valve. It eliminates surge as load starts down. Load-weight controls rate of descent.

Benton Harbor Engineering Works, Inc.
St. Joseph, Michigan

SOMETHING NEW for PNEUMATIC APPLICATIONS!
The Auto-Diesel GAPLESS Piston Ring GIVES GREATEST POSSIBLE COMPRESSION

Pat. No. 2,738,243

For years Auto-Diesel Engineers have been developing a GAPLESS Piston Ring especially for pneumatic applications. The new (Patent No. 2,738,243) Auto-Diesel GAPLESS Piston Ring is a departure from conventional rings. There is positive seal with no chance of blow bys and this results in the greatest possible compression. It is adapted for carrying oil within itself if desired. It can be made a contracting ring for sealing shafts, bearings, or replacing packings, etc., and many other applications. It can be used as original or replacement in pneumatic operated industrial equipment, and for normal pressure hydraulic. Made in sizes for 2" and up. Users of pneumatic and normal pressure hydraulic equipment will find that Auto-Diesel GAPLESS Piston Rings will give longer service and assure the greatest possible compression. Send for complete information.

Write for Details

THE AUTO-DIESEL PISTON RING CO.
3137 Superior Avenue • Cleveland 14, Ohio
"RINGS and SHAPES Since 1921"

New Products / continued

AIR VOLUME BOOSTER
. . . for fast cylinder action

Designation: Governaire Series 4500

Features: Booster has flow capacity of 115 cfm when signal pressure is 10 psi and supply pressure is 50 psi. With a 150-psi supply,

capacity is 170 cfm. Unit may be used to shorten time lag caused by long transmission lines. Booster has small size, exeremely light weight and good tolerance of foreign matter. Pipe mounting in any position without brackets is permissible. Units are available for ⅜, ½, and ¾-inch pipe sizes in ratios of 1:1, 1:2, 1:3, 2:1, and 3:1. Balanced supply valve design provides almost complete immunity to variations in supply pressure.

Governaire Div.
Bellofram Corp.
Burlington, Mass.

Circle 146 on Reader Service Card

OIL ADDITIVE
. . . increases lubricity

Designation: Hyperoil

Features: Light viscosity, halogen cresyl compound is added to hydraulic fluid 2% to 5% by volume

and reduces heating, gumming, and maintains lower temperature without compression changes. Fluid is a metal preservative, rust preventative and concentrated lubricant. Used on machine members, lubricant increases film strength, reduces galling and seizure, and decreases heat of spindles and bearings. Material has been shown to increase pump life by 250%.

Destiny Products Co.
Detroit, Michigan
Circle 147 on Reader Service Card

AIR PUMP
. . . 2-stage piston type

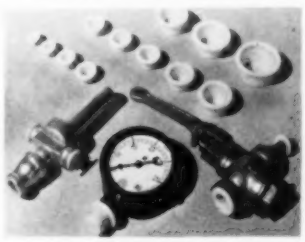
Performance: Unit is rated for 1000 hours service life and 300 hours continuous operation at altitude of 60,000 ft. Rated capacity of pump is 575 cipm free air delivery at 32 in. Hg absolute inlet pressure. Displacement of first stage pump is 2.165 cu. in. per stroke and second stage pump is .685 cu. in. per stroke. Crank shaft operates at 2700 rpm.

Construction: Each of two reciprocating pumps has oil-free, carbon-graphite composition sleeve shrunk into its steel cylinder. Steel piston maintains a close running fit on the self-lubricating cylinder sleeve and adequately seals against leakage without the aid of piston rings. Ball bearings of the piston rod and crank shaft are lubricated for 1000 hours service. Unit will start and operate at rated capacity in ambient temperature of —65 degrees F.

Lear-Romec Div.
Lear, Inc.
Elyria, Ohio
Circle 148 on Reader Service Card

THREAD PROTECTORS
. . . of Tenite

Features: Caps are molded of Tenite polyethylene manufactured by Eastman Chemical Products, Inc. and give threaded parts effec-



tive protection against dust, dirt, and damage. They serve either as caps over external threads in a ma-

Continued on next page

Circle 81 on Reader Service Card

Quality
HYDRAULIC PACKINGS
NEOPRENE-FABRIC COMPOUND & HOMOGENEOUS
"V" CUPS
"U" FLANGE
"O" RINGS
Periflex Inc.
HAZEL PARK • MICHIGAN

NEW!
REPUBLIC
SELECTOR
VALVES
NEW!

"LO-TEMP"
—65° without lubricant

LO-TORQ SELECTOR
BALANCED PRESSURE FOR EASY TURNING

With service pressure and seals on both sides of valving disk, turning is easy. Design is simple—maintenance is low. Many services—Air, and gas 4000 psi; fuel, hydraulic oil, petroleum, water, 6000 psi. Made in bronze, semi-steel, aluminum alloy, in three different portings, ⅛" to 1". Request Bulletin No. 454.

LO-TEMP SELECTOR

Teflon plug ends the need for lubricant. Easy turning—non seizing. -65° to 250°F. 2- 3- 4-way. 100 psi service. Made in aluminum alloy or stainless steel. ⅛" to 1" pipe or tube. Request Bulletin No. 754.

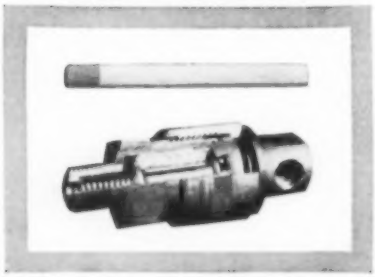
"LO-TORQ"
6000 psi service

145

RM
REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

Circle 54 on Reader Service Card

NOW TRY HUSCO
Hydraulic Control-Engineering for Improved Performance, —Space and Cost-Saving



Every Husco Hydraulic Control is custom-engineered for your equipment! We have no "standard" models to push. But our successful experience with hundreds of difficult control problems—confirmed by case histories—promises you the *right* control for your needs . . . Control Valves, Check Valves, Reciprocating Valves, Hydraulic Cylinders, Pumps, Power Units—they're all engineered to your specific equipment demands for size, capacity, performance.

Check HUSCO *first* for precision engineered Hydraulic Units. You'll save time, money and worry. Write for details.

HUSCO **HYDRAULIC UNIT SPECIALTIES CO.**
Pumps • Valves • Cylinders
Waukesha, Wis.

New Products continued

chined part, or as plugs to protect internal threads during assembly, shipment, or storage. The resilient caps are made in green or yellow and are available in sizes and styles to fit all threads and openings.

Clover Industries, Inc.
Tonawanda, New York
Circle 149 on Reader Service Card

HYDRAULIC POWER UNIT . . . for mobile equipment

Designation: Lectro Lift.

Design: Unit consists of 6 or 12-volt d-c motor drive, pump, control valve and tank. Rectangular

housing of cast aluminum serves as the reservoir for 110 cubic inches of oil. Electric motor is flange-mounted to one end of the housing and the pump control valve to the opposite end. All working parts are totally enclosed for full protection from outside elements.

Operation: Control is obtained by one lever which can also accommodate a clevis for remote control linkage. It has three operating positions: raise, lower, and spring return to hold. Lowering control is through a throttling valve for varying the rate of return. The unit may be mounted vertically or horizontally.

Wisconsin Hydraulics, Inc.
Milwaukee, Wisconsin
Circle 150 on Reader Service Card

SOLENOID VALVE . . . for air application

Designation: Bulletin 8210A

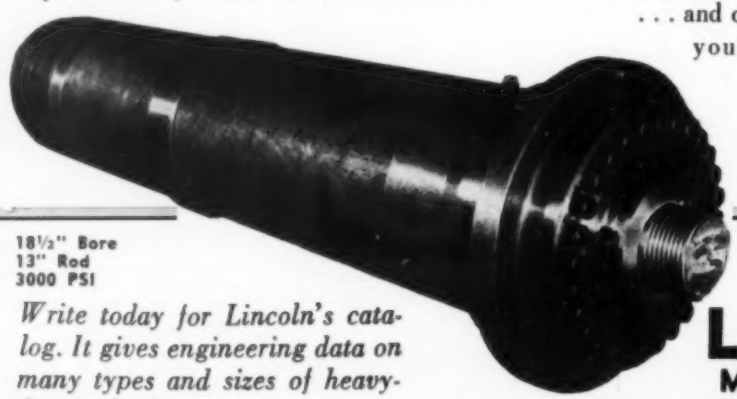
Construction: ¾-inch, 2-way valve is internal pilot operated and has just three operating parts—a stainless steel core and spring and a hycar diaphragm. Packless construction is used with no stuffing

Air and Hydraulic Cylinders

• FOR HEAVY-DUTY APPLICATIONS OF ALL TYPES • TO MEET ALL SIZE AND PRESSURE REQUIREMENTS • BORES TO 60″ DIAMETER • STROKES OF 50 FT. AND LONGER

Lincoln Machine Company will design, engineer and build standard or special hydraulic and pneumatic cylinders with trunion, rod-end flange, blank-end flange, foot, clevis or centerline mountings.

Call on Lincoln when you require large, powerful rotating or non-rotating hydraulic and air cylinders, heavy-duty mill-type cylinders. Our engineering department will give you fast, practical assistance in design problems . . . and our modern plant will build your cylinders quickly and economically.

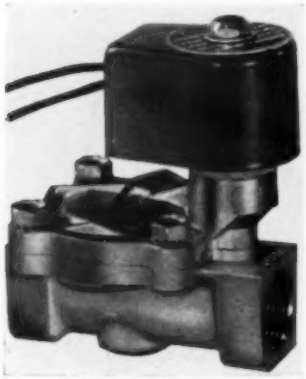


18½" Bore
13" Rod
3000 PSI

Write today for Lincoln's catalog. It gives engineering data on many types and sizes of heavy-duty cylinders.

LINCOLN MACHINE CO., INC.
326 West 2nd Street—Salem, Ohio

boxes or sliding glands to leak or require maintenance. Unit is available with either pressed steel, water-tight, or explosion-proof sole-



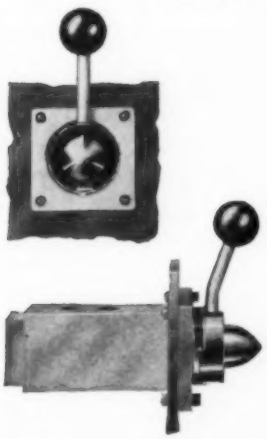
noid enclosure in normally open or normally closed types. Special coils for extreme humid conditions and dual voltage coils can be provided.

Automatic Switch Co.
Orange, New Jersey

Circle 151 on Reader Service Card

FLOW REGULATOR . . . for panel mounting

Features: Adjustable valve is applicable to systems requiring a variable flow over a wide operating



range. Unit has aluminum body with internal parts of hardened steel and an adjustable control handle for either right or left rotation.

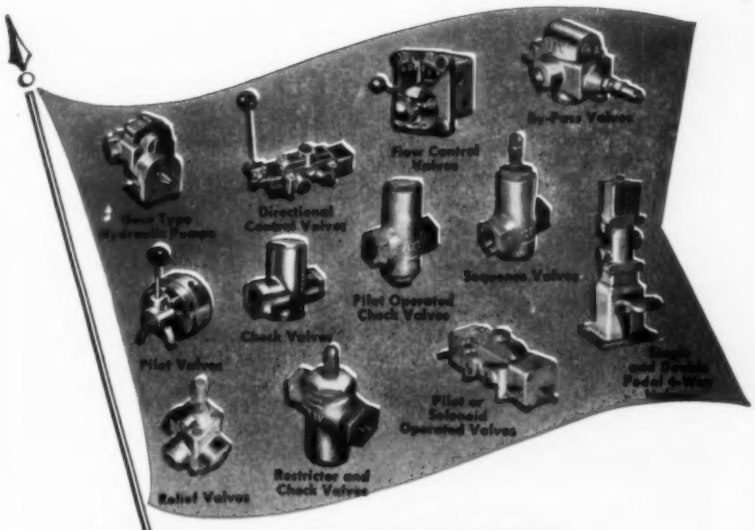
Waterman Engineering Co.
Evanston, Illinois

Circle 152 on Reader Service Card

TURRET LATHE DRIVE . . . . . is hydraulic package unit

Features: Turret drive is low cost method of modernizing hand turret lathes and is easily adapted to any

Continued on next page



BY ANY STANDARD...

ADEL *Refinements* assure Plus Performance for Your Equipment

Designers and Engineers have set these standards for Industrial Hydraulic Equipment

Rugged simplicity • Long life • Simplification of piping • Reduced installation costs • Greater accessibility for maintenance • Completeness of line • Over-all economy

ADEL brings them all to you!

Smooth economical hydraulic power for Pushing, Pulling, Lifting, Pressing, Clamping and Controlling.

Illustrated are but a few of a wide variety of ADEL industrial hydraulic control equipment that offer definite benefits to both the user and builder of machine tools and many other kinds of equipment. ADEL products incorporate proven design and precision construction features that assure dependable operating efficiency over the years. A complete line for every application. You can simplify your Hydraulic Power Motion Problems by specifying ADEL.

For complete engineering specifications and counsel, Address: ADEL DIVISION, GENERAL METALS CORPORATION, 10771 Van Owen Street, Burbank, California

ADEL
PRECISION PRODUCTS
A DIVISION OF GENERAL METALS CORPORATION

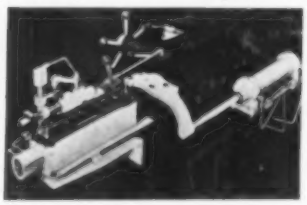
Manufacturers of Industrial Hydraulic Control Equipment

DISTRIBUTORS: AIR-DRAULIC EQUIPMENT CO., HOUSTON, TEX. • AIR & HYDRAULIC ENGINEERING CO., NEW HAVEN, CONN. • RUSS CHAMBERLIN COMPANY, PORTLAND 14, ORE. J. BOYD COATES, GLENSIDE, PA. • CORBY SUPPLY COMPANY, ST. LOUIS, MO. • FRANK T. DONNELLY COMPANY, PITTSBURGH 38, PA. • HASKEL ENGINEERING & SUPPLY CO., GLENDALE 4, CALIF. • HASKEL ENGINEERING & SUPPLY CO., SAN FRANCISCO 7, CALIF. • AIR-DRAULICS COMPANY, PHOENIX, ARIZ. • INDUSTRIAL AIR & HYDRAULIC EQUIP. CO., DETROIT 15, MICH. LINCOLN SUPPLY COMPANY, PROVIDENCE, R. I. • L. H. MONSEES, INDEPENDENCE, MO. • THE NEFF ENGINEERING CO., FORT WAYNE 3, IND. • POWER DRIVES, INCORPORATED, BUFFALO, N. Y. • SCOTT EQUIPMENT & ENGINEERING CO., DAYTON 10, OHIO • ROBERT TAYLOR & SONS, SALT LAKE CITY 10, UTAH • WYATT SALES COMPANY, CLEVELAND 15, OHIO
TRI-STATE SUPPLY COMPANY, BROOKLYN 33, N. Y.

Circle 3 on Reader Service Card

New Products continued

standard ram-type turret lathe Nos. 1, 2, 3, 4, or 5. Operation is started with a hand control valve. The master valve then controls the required operations in a preselected



sequence. Precise adjustments for any desired cycle (rapid traverse, feed, dwell, and quick return) are quick and easy to set up.

Design: Package consists of master control unit including valves, master control valve, pump and motor unit with 1½-hp motor and 8-gpm pump, and power cylinder unit with 12-inch maximum travel and 8295-lb. maximum thrust at 1000 psi.

A. W. Cash Co.
Decatur, Illinois

Circle 153 on Reader Service Card

SYNTHETIC HOSE
. . . for high temperatures

Features: Lightweight hose can be used effectively at elevated temperatures and is capable of handling air continuously at temperatures to 400 degrees F and working pressures of 100 psi. Hose can be made with inside diameters from ¾ to 5 inches in lengths to 50 feet and is exceptionally strong, lightweight and flexible.

Quaker Rubber Div.
H. K. Porter Co., Inc.
Philadelphia, Pa.

Circle 154 on Reader Service Card

NOISE ATTENUATOR
. . . reduces exhaust noise

Designation: Series 4-44 Atomuffler

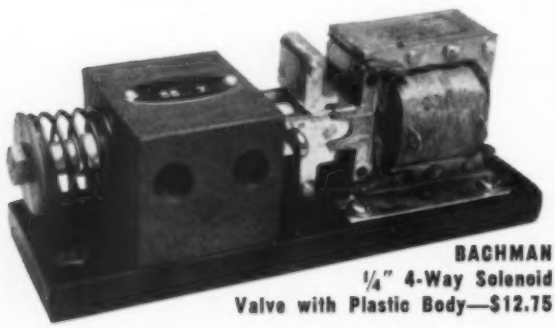
Features: Unit has internal resonator and new air diffuser having a larger exhaust radiation area with 250% greater air flow capacity. Injurious exhaust loudness is completely eliminated. Workers are protected from noise reverberations because unit stops noise at its source.

Construction: Attenuator has stronger, more durable construction

for long trouble-free performance. Compact unit is available in eight pipe sizes from ⅛ to 2-inch NPT. Units are made with a male pipe thread for direct connection to the exhaust port of air operated equipment.

Allied Witan Co.
Cleveland, Ohio

Circle 155 on Reader Service Card



BACHMAN
¼" 4-Way Solenoid
Valve with Plastic Body—$12.75

If you are looking for low cost dependability here is a constant duty direct solenoid valve for 200 psi with ¼" orifice—at a price below most hand operated valves. The body is machined from tough canvas base phenolic with ports perpendicular to the laminations.

These valves give millions of cycles of quiet and trouble-free service because the resilient construction *quietly* absorbs the kind of punishment that damages harder materials.

Stems are hardcoated aluminum and permanently resist wear or abrasion. Seals are standard O-rings.

With these units you can operate, check or cushion air cylinders. In air-hydraulic systems they will provide positive check or dwell. Use them for many combinations of manual or automatic control. The valve illustrated is 7" long, weighs 2 lbs. and mounts in any position. Other models have double solenoid and also hand, foot or mechanical actuation. All have ½" stroke with spring return optional.

Let us mail you complete literature or ask us to send you one of these units for a 30 day test and decide for yourself whether this long life leakproof valve can save you money.

JOHN D. BACHMAN & CO.

1713 Sparger Lane — Bristol, Tennessee

Circle 16 on Reader Service Card

What a sight!

CENTURY'S

All-new Oil Level Sight Gage

- **No Easier Installation Ever Designed**
- **Better Visibility at any Height**
- **Leak-proof—No Dripping**
- **Streamlined Modern Appearance**
- **Important Savings in COST**
- **Available NOW From STOCK**

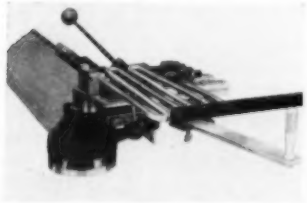
Inquire today . . . make immediate use of the sensational advantages in cost and services offered by this new gage . . .

CENTURY HYDRAULICS, INC.
7701 LYNDON AVE. • DETROIT 38, MICHIGAN
Telephone: DIAMOND 1-3797

Circle 24 on Reader Service Card

COIL BENDER
. . . for continuous coils

Performance: Bender produces continuous serpentine coils from a single length of tubing, without removing tubing from the machine. Accurate and uniform one-piece coils can be produced in minutes by relatively unskilled operators. Unit bends annealed ferrous and nonferrous tubing from ¼ to 1-inch OD. Machine can be easily adapted to all standard bending.



Leonard Precision Products Co.
Santa Ana, California

Circle 156 on Reader Service Card

RELIEF VALVE
. . . 1/8-inch pipe size

Designation: 5100 Series

Features: Valve is available in brass or steel for pressures from 50 to 1000 psi. Unit is adjustable internally, and is tamperproof when installed. Compact, lightweight is provided by in-line design and contributes to ease of mounting and functional appearance of valve which has excellent flow characteristics without complication of pilot operation.

Design: Use of an O-ring seal and spring centering device allows only axial force to be transmitted to the poppet and results in a valve that combines sensitive operation with unusual durability. Valve has no leakage within 2% of preset cracking pressure and reseats with no leakage within 5% of the setting. It is well suited to nearly all gas and liquid applications.

James-Pond-Clark
Pasadena, Calif.

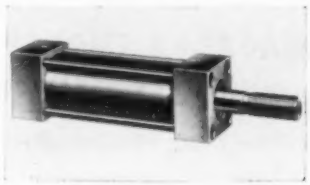
Circle 157 on Reader Service Card

AIR-OIL CYLINDER
. . . low friction

Designation: Model D

Design: Cylinder has no metal-to-metal contact between piston and cylinder wall. Tough nylon bearing is wrapped around outer diameter of piston. Unique cushion arrangement with cadmium plated spring, spherical radius seal, and chamfered seat assures positive cushioning with immediate acceleration on the return stroke. Cushions are available for controlled strokes from 1 to 6 inches. Three-way flush rabbet mountings for front, rear, and horizontal are standard.

Construction: Cylinder barrel is roller burnished to fine micro-inch finish and hard chrome plated. Cylinder head is machined from high tensile heat treated extruded aluminum bar, and piston rod is hardened, ground, and polished stainless. Cylinder operates at 250 psi air or 500 psi water or oil and is made to exceed JIC Standards.



Alkon Products Corp.
Hawthorne, N. J.

Circle 158 on Reader Service Card

OUTLASTS ANY OTHER PIPE JOINT COMPOUND

PLS*

John Crane *Plastic Lead Seal seals for the life of the connection, regardless of vibration, expansion or contraction, temperatures to 550°F. or pressures to 6000 psi. Yet connections can be easily disassembled any time, because PLS remains plastic at all times.

It costs less to use PLS, because it takes less to make a perfect seal on pipe joints, plugs screwed fittings, flanges and gaskets . . . ideal for water, oil, gas, steam, refrigerants, chemical and petroleum products.

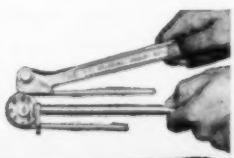
Send today for a Free Sample.

Available in 1-lb. cans (brush top or friction), 5-lb. cans, 15 and 28-lb. pails, 85-lb. drums or 4-oz. plastic tubes.

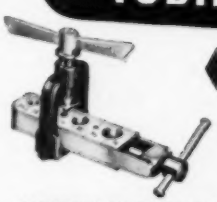
JOHN CRANE CRANE PACKING COMPANY
6405 Oakton Street, Morton Grove, Illinois
Crane Packing Company, Ltd., Hamilton, Ont.

IMPERIAL BLUE DOT TUBE BENDERS

Bend hard or soft tubing. Form neat accurate bends to short radius. Calibrated. No. 364-FH individual benders for each size of tubing 3/16" to 3/4" O.D. Also many other models.



Avoid Lost Time and Grief
with modern, efficient
IMPERIAL
TUBING TOOLS



IMPERIAL FLARING TOOLS
All types, for making 45°, 37° and double flares . . . on copper, aluminum, steel and stainless steel tubing. No. 500-F Flaring Tool illustrated, makes 45° flares and then burnishes them.

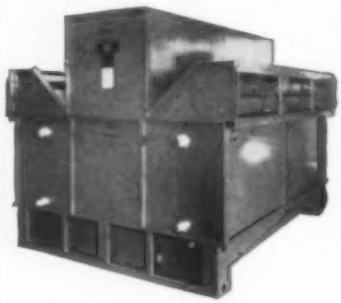
IMPERIAL HI-DUTY TUBE CUTTER
Free wheeling ball bearing action. Roller type with flare cut-off groove. Retractable reamer. No. 274-F for 1/8" to 1" tubing. Other models. Also sawing vises.

Ask for Catalog No. 3011

See Your Supply House

THE IMPERIAL BRASS MFG. CO., 1242 W. Harrison St., Chicago 7, Ill.
In Canada: 334 Lauder Ave., Toronto, Ontario

IMPERIAL Industry's Most Complete Line of Tube Fittings and Tubing Tools



NIAGARA SECTIONAL *Aero* HEAT EXCHANGER gives close temperature control, saves you LABOR, Power, Water

- **Because the new design improves the heat transfer to the out-door air by evaporation.**
- **Because new features keep your equipment working for long life with "new plant" efficiency . . . always full capacity.**
- **Because you save 95% of cooling water cost.**

You get faster, more accurate cooling of industrial fluids to specified temperatures.

You improve your quality of production by removing heat at the rate of input.

You save labor in upkeep. With full access to all interior parts and piping you see everything in easy inspections. You head off dirt accumulation and corrosion. Casing panels are removable without moving the coils. The coils can be cleaned from both sides.

First cost is low; freight is low because of the lowest space/weight ratio; you save much labor in erection. Capacity range is 7,000,000 to 18,000,000 Btu/hr. No other heat exchange method gives you so much saving in money and convenience.

Write for Niagara Bulletin No. 132

NIAGARA BLOWER COMPANY
Dept. AH, 405 Lexington Ave.
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

Useful Literature continued

ROTARY AIR PUMPS . . . form the subject of 12-page Catalog 755 released by Leiman Bros., Inc. This publication gives details of construction, dimensions, capacities and performance curves on the complete line including 4-wing types, 2-wing types, double-cylinder types, motor driven models, integral pump and motor units, air motors, and a full line of accessories.

Circle 187 on Reader Service Card

PRESSURE & TEMPERATURE CONTROLS . . . products of United Electric Controls Co. are included in the company's Catalog 52. Included is a local-mounted immersion type thermostat which has a calibrated or uncalibrated adjustment with operating limits to 425 degrees F. Skeleton thermostats are also shown for use in applications where space or weight is limited. Pressure controls for 180 psi are especially applicable for close differential pressures. The pressure switches are also available for pressures to 200 and 500 psi.

Circle 188 on Reader Service Card

MOTOR CONTROL . . . which permits savings up to 50% in floor area is described in a new 24-page bulletin designated GEA-6367 by General Electric Co. The publication describes the construction and application of the control center and lists ratings, weights, dimensions, and installation data. The control center is designed to accommodate starter units of either the fusible or circuit breaker type in NEMA Sizes 1 through 5. It is available in ratings of 1 to 200 hp, 110 to 600 volts, 3-phase.

Circle 189 on Reader Service Card

TEFLON PRODUCTS . . . including basic shapes such as rod, tube, sheet, and slab as well as V-rings and O-rings are listed in a folder from Balfour Industries, Inc. O-rings are available in AN specification sizes and in inch sizes. The newly formed company also manufactures gaskets and packings of neoprene, silicone rubbers, and other materials.

Circle 190 on Reader Service Card

MARINE HOSE . . . and reusable fittings are the subject of 41-page Catalog 300 now available from Aeroquip Corp. This first catalog ever produced on flexible piping for marine applications is fully illustrated and includes planning information, bend radii data, pressure and vacuum data, and other important engineering information. Installation procedures for various types of hose are clearly illustrated throughout the catalog which also includes instructions for selection and installation of hose. Charts of bend radius vs. operating pressure are included. The hydrauliscope, a special oscilloscope for analyzing pressures in a hydraulic system, is also specified in the catalog.

Circle 191 on Reader Service Card

CLUTCHES . . . for over-running, indexing, and back-stopping applications are outlined in Catalog 103-C released by The Formsprag Co. The catalog includes cutaway photos, cross section drawings, dimensions and engineering data for an all-purpose ball bearing clutch, sleeve bearing clutch, and a special purpose ball bearing clutch. Also included are basic installation and maintenance instructions. The clutches offer the advantages of no measurable backlash, high torque capacity for size and weight, internal simplicity, and long life.

Circle 192 on Reader Service Card

ROTARY SOLENOID . . . which has pure rotary motion and no axial shift is presented in a brochure from Leetronics, Div. of Lee Spring Co., Inc. The information specifies three a-c types and includes a chart of torque vs. rotary stroke for each. Solenoids are available with torque values from fractional in-lbs to 62.5 in-lbs at maximum stroke, continuous duty. Standard rotations are for 20, 30, and 45 degrees. The units are unaffected by vibration and shock and operate in any position. Various applications of the solenoids are illustrated.

Circle 193 on Reader Service Card

LIMIT SWITCHES . . . Seven models and nineteen contact arrangements are described in the new Catalog No. 955 offered by R. B. Denison Mfg. Co. Complete purchasing and specification data on each of these switches is given including information on housings,

Continued on page 118

Circle 66 on Reader Service Card

HOSE RESCUE

by

Mayson Hose Swivels

Do you have a number of hose lengths broken at the coupling? They can be rescued by cutting to shorter lengths and fitting with Mayson Hose Swivels.

Your Mayson dealer stocks the swivels which will give you hoses like new, yes, better than new because they won't break again. Catalog and dealer's name upon request.

J.I.C. Standards
Sizes ¼" to 2" P.T.
Male or Female

MAYSON MFG. CO.

4332 Horatio Street • Detroit 10, Mich.

Circle 7 on Reader Service Card

you need

MOLYKOTE® Lubricants

IF YOU HAVE LUBRICATION PROBLEMS IN THESE APPLICATIONS

CHECK OFF THE ONES WHICH ARE GIVING YOU TROUBLE

- ☐ EXTREME BEARING PRESSURES
- ☐ EXTREME TEMPERATURES
- ☐ UNUSUAL ENVIRONMENT
- ☐ MATING SURFACES OF SAME OR SIMILAR MATERIALS
- ☐ FRETTING
- ☐ HIGH STARTING FRICTION
- ☐ RUBBER ON METAL
- ☐ LIFETIME LUBRICATION
- ☐ RESISTANCE TO CENTRIFUGAL FORCE

Even if you have checked only one of these sources of lubrication problems, you need MOLYKOTE. Tell us which ones you have checked and we will mail you pertinent literature.

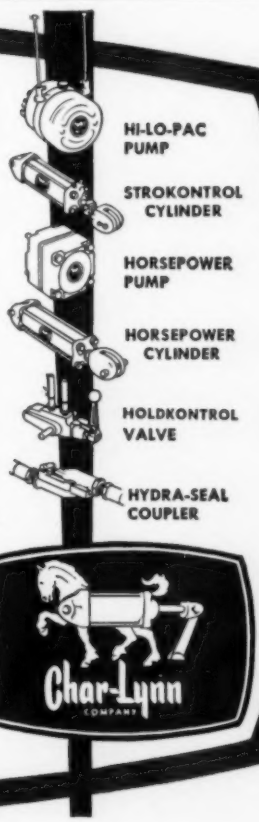
The ALPHA MOLYKOTE Corporation

Main Factories: 67 Harvard Avenue, Stamford, Conn.
71 Arnulfstrasse, Munich 19, Germany

only **HI-LO-PAC** offers all these important features

HI-LO-PAC is a complete hydraulic system enclosed as a single unit.

- Two pumps
- Two valves
- Filter
- Pressure Relief Valve
- Reservoir
- 200 to 1200 RPM
- 3 to 12 GPM
- Up to 1000 PSI
- Direct PTO Drive
- Mounting Kits for all tractors



Char-Lynn HI-LO-PAC

America's leading power unit, serves on more than 200,000 farms daily, giving great service at low cost.

Write for **FREE** *Catalog!*

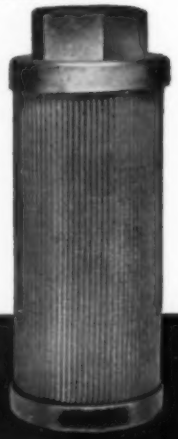
CHAR-LYNN COMPANY

Dept. AH-4, 2843-26th Avenue South, Minneapolis 6, Minnesota
Member—National Fluid Power Association

Circle 25 on Reader Service Card

Circle 22 on Reader Service Card

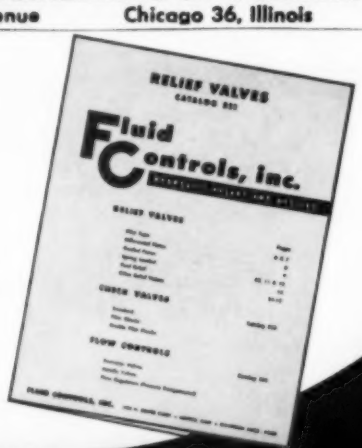
★ONLY THREE PARTS
★MEETS J.I.C. STANDARDS
★GREATER FILTERING AREA
★SPECIAL TRAP-WEAVE MESH



The New
CAPITAL HYDRAULIC OIL FILTER
WITH MONEL METAL INSERT
Reservoir Type for Hydraulic and Oil Re-Circulating Machinery
EASY TO INSTALL • EASY TO CLEAN • LONG LIFE • LOW COST
SIZES AND SCREENS TO FIT YOUR NEEDS

CAPITAL ENGINEERING & MFG. CORP.
5837 South Ashland Avenue Chicago 36, Illinois

NEW!
16 Page
Relief Valves
Catalog



For The Designers and Engineers
Of Hydraulic Systems

Packed with information, illustrations and technical data on —
- Pilot Type
- Guided Piston
- Dual Relief
- Differential Piston
- Spring Loaded
- Other Relief Valves

For your copy, write request on company letterhead.

Fluid Controls, inc.
Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators
1284 N. CENTER STREET • MENTOR, OHIO

Useful Literature continued

wiring diagrams, ampere ratings, operating data and electrical characteristics. Four different types of mounting plates are described with two top covers (plastic and metal) and 150 lever styles. The switches have a fast electrical break, low bounce and light impact, and an O-ring shaft seal insuring a tight enclosure. A large cutaway view illustrating these features with an identification of parts is shown.

Circle 194 on Reader Service Card

MOTOR INDEX . . . consisting of a file of over 900 special designed motors of practically every conceivable size and shape is available from Reuland Electric Co. While originally designed for special powering jobs, the motors listed are often suited, or adaptable to other applications with similar drive needs. The purpose of the "library" is to save the expense and delay of special motor development. Individual sample units can be quickly made available for pre-production test running of equipment.

Circle 195 on Reader Service Card

SOLENOID CONTROLLED VALVE . . . which is pilot operated and subplate mounted is discussed in Catalog 54-B issued by Racine Hydraulics & Machinery, Inc. The 2000-psi, 4-way valve conforms to JIC Standards and has a balanced piston with no side thrust, and no end thrust. A honed sleeve construction assures a smooth continuous riding surface for the piston, and a smooth, throttled reversal is obtained through the round holes in the sleeve. These holes can be elongated to increase throttling action when desirable. Dimensions of the valve are given with detailed cutaway and sectional drawings.

Circle 196 on Reader Service Card

LUBRICATION PUMPS . . . both non-directional and with a reversing feature are explained in Catalog No. 108 issued by Tuthill Pump Co. Models LF and LFD are for non-directional service and have external or internal porting and flange mounting. Models RF and RFD are for applications where space is limited and the pump must be driven by a reversing shaft. Sectional views and dimensions are given as well as performance curves for the pumps which range in capacity to 170 gph.

Circle 197 on Reader Service Card

PLASTIC HOSE . . . for pneumatic pressure to 125 psi is specified in a brochure released by Hofmann Engineering Co. Sizes from 3/16 to ½-inch ID for flows of 25 to 340 cfm are specified. A chart showing results of a test indicates that it is possible to use a smaller ID plastic hose because of the free flow characteristics. The smooth bore of the hose reduces turbulence and will not flake when used with automatic airline lubricators.

Circle 198 on Reader Service Card

O-RINGS . . . and rectangular section rings are featured in a brochure from Goshen Rubber Co., Inc. showing the company's facilities and products. The rectangular section rings, called tetraseals, are static seals interchangeable with standard O-rings. They are made in one homogeneous piece and the edges are accurately formed. Cross sectional tolerances can be held to ± .004 depending on inside and outside, size of cross-section and material. The company's O-rings are made from natural, synthetic and silicone rubber compounds to MIL, AMS, SAE, ASTM and industrial specifications .

Circle 199 on Reader Service Card

HOSE COUPLINGS . . . Comprehensive Bulletin No. 105 has been announced by the LE-HI Div. of Hose Accessories Co. The illustrated bulletin contains complete information on the wide variety of steel, malleable iron, and brass hose couplings and nipples for industrial rubber hose in suction, water, and petroleum applications.

Circle 200 on Reader Service Card

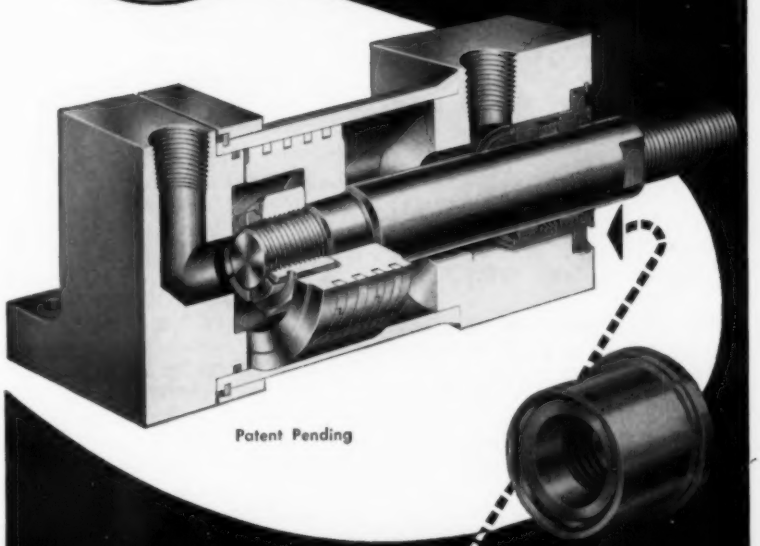
AFTERCOOLERS . . . manufactured by Niagara Blower Co. are discussed in Bulletin 130 presented by the company. These units produce drier and cooler compressed air and protect air tools and pneumatic systems from water damage. Several diagrams illustrate the function of the aftercoolers which are available in sizes from 200 cfm to 12,000 cfm free air capacity matching compressor sizes from 40 hp to 2500 hp. Numerous applications are pictured in the bulletin.

Circle 201 on Reader Service Card

VARIABLE SPEED TRANSMISSION . . . with output speeds from 0 to ¼ the input speed is described in a booklet from Revco Inc. The unit which can be used for driving a hydraulic pump takes speeds up to

Continued on next page

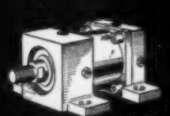
High Pressure HYDRAULIC CYLINDERS



Patent Pending

Cut downtime with "quick-change" rod packing cartridge

- 2,000 P.S.I.
- J. I. C. STANDARDS
- COMPACT DESIGN
- OPTIONAL ROD SIZES
- ALL-STEEL CONSTRUCTION
- 11 TYPES OF MOUNTINGS
- 11 BORE SIZES—1½" TO 8"
- UP-TO-DATE ENGINEERING



The S-P "quick-change" packing cartridge is easily removed for servicing seal or wiper. ***Cuts downtime . . . speeds production.*** S-P Hydraulic Cylinders have ***every*** modern design feature. Representatives in principal cities. Prompt deliveries. Send for Catalog 104. The S-P Manufacturing Corp., 12415 Euclid Ave., Cleveland 6, Ohio.

THE S-P MFG. CORP. — Cleveland
A Bassett Company
PRECISION PRODUCTS SINCE 1916

AIR AND HYDRAULIC CYLINDERS • POWER CHUCKS • ROTATING AIR CYLINDERS
COLLET AND DRILL PRESS CHUCKS • AIR PISTONS, VALVES AND ACCESSORIES

Circle 92 on Reader Service Card

Useful Literature continued

2000 rpm at the input and delivers an infinitely variable speed from the output shaft. Instant speed change is provided at any time and the unit gives positive drive with constant torque conversion throughout its speed range. Models are available with output torque ratings through 100 inch pounds for use with 1/40 to 3/4 hp motors. Operation and design of the transmission is fully explained in the booklet, and numerous applications are described. Basic information on drives including examples and torque computations is included.

Circle 202 on Reader Service Card

AIR & HYDRAULIC VALVES . . . cylinders, and power units manufactured by Rivett Lathe & Grinder, Inc. are presented in a condensed catalog available from the company. Featured are cross-section views of cylinders and valves, and seven cylinder mounting styles are diagrammed. Standard power units consisting of reservoir, pump, motor, and associated equipment are available in 17 models at continuous working pressures to 1000 and 1500 psi. Single pumps are available in six tank sizes from .4 to 40 gpm and double pumps are offered in four tank sizes with combined capacities from 3.5 to 80 gpm.

Circle 203 on Reader Service Card

PNEUMATIC SPEED CONTROL . . . which screws directly into valve exhaust port is inexpensive unit described in a Modernaire Corp. data sheet. The unit is adjusted to throttle exhaust air for a desired piston-speed. The Model 500 is machined from non-corrosive materials and has simple, trouble-free design. The unit is available for ¼, ⅜, and ½-inch ports. Also released by the company is an application sheet showing a pneumatic circuit for automatic clamping, work stroke, and return.

Circle 204 on Reader Service Card

O-RING SIZES CHART . . . is presented in Catalog 5701 from Parker Appliance Co. The 12-page booklet gives cross reference charts of size numbers with dimensional data for all the company's O-rings for sealing applications. Condensed charts of standard synthetic rubber compounds are also included in the catalog. The company's 2-XX series covers sizes of AN 6227B, AN 6230B, MS 29513 and other series plus the 38 additional sizes of the new MS 9021 series. These added to the AN 6290 series and 50 sizes of the company's 5-XX series provides a total of 296 standard O-ring sizes available.

Circle 205 on Reader Service Card

ELECTRICAL CONTROLS . . . General Control Co. has released a condensed catalog to indicate their line of timers and electro-mechanical switches. This compact bulletin shows pictures, diagrams, and general specifications covering standard and special foot, lever, limit, and pushbutton switches as well as electronic and synchronous-motor timers and custom control panels. Bulletins which give more complete information on the products are listed.

Circle 206 on Reader Service Card

"Wipe out" PACKING FAILURES WITH Seal-Guard METALLIC ROD WIPERS

Self-adjusting, easy to install, Seal-Guard's knife-like bronze rings "wipe off" all dirt and grime, will not mar the rod, are oil and heat resistant and friction-free.

HOW SEAL-GUARD WORKS

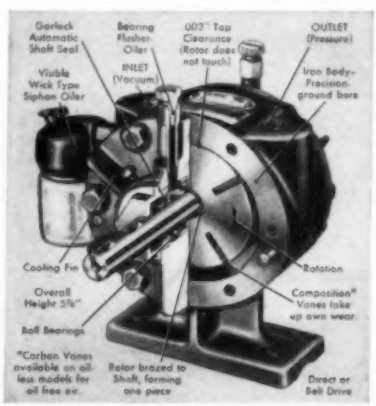
1. Twin wiper rings are mounted on rod with notches staggered.
2. Cushion ring is compressed on assembly exerting constant inward pressure keeping ring in constant contact with rod.
3. Harmful substances are completely cleared by scraper action.

Seal-Guards are available to fit rod diameters from ¼ to 24 inches. Other sizes by special order.

WRITE FOR DESCRIPTIVE LITERATURE.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

Circle 52 on Reader Service Card


Garlock Automatic Shaft Seal
Bearing Flusher-Oiler
.002" Top Clearance (Rotor does not touch)
OUTLET (Pressure)
Visible Wick Type Siphon Oiler
INLET (Vacuum)
Iron Body—Precision-ground bore
Cooling Fin
Rotation
Overall Height 5⅝"
Composition* Vanes take up own wear.
Ball Bearings
*Carbon Vanes available on oil-less models for oil free air.
Rotor brazed to Shaft, forming one piece
Direct or Belt Drive

Quality and simplicity keep efficiency high on

GAST rotary vane AIR PUMPS

This cutaway reveals why Gast Air Pumps are in demand for plant use and original equipment. Manufactured to high quality-precision standards, all models embody this efficient, simple rotary-vane design. Rotor is balanced; sliding vanes light in weight for minimum motion-energy-friction loss compared to other pumps. As vanes take up their own wear automatically, pump delivers full performance for years.

Write for "Application Ideas" booklet and catalog—mention capacity you need. **Gast Manufacturing Corp.** P. O. Box 117-D, Benton Harbor, Michigan.

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY
• AIR MOTORS TO 4 H.P.
• COMPRESSORS TO 30 P.S.I.
• VACUUM PUMPS TO 28 IN.
See Our Catalog in Sweet's Product Design File

Circle 42 on Reader Service Card

TANK FILLER CAP . . . which is applicable to hydraulic reservoirs is presented in a data sheet from Gabb Special Products. The unit, designated FC-3500 meets all test requirements of MIL-C-7244B ASG and is removed with only a 35-degree turn. The cap is a self-contained unit and opens safely under pressure. The unit is opened and closed without tools and has a simple lever action design. A full 3-inch opening is provided by the cap which weighs .43 lb. The unit is pictured and a dimensional drawing is included.

Circle 207 on Reader Service Card

PISTON RINGS . . . which are wrought from strip stock and formed in a precise process are discussed in a leaflet from Precision Piston Rings, Inc. Designed for die casting machine plungers, the rings have been developed to withstand temperatures to 1200 degrees F and are hardened to Rockwell C-48-55 to assure long life and minimum wear. The rings are unbreakable. Special tempering for flexibility and toughness produce an active, live metal that assures a positive resilient seal for the life of the ring.

Circle 208 on Reader Service Card

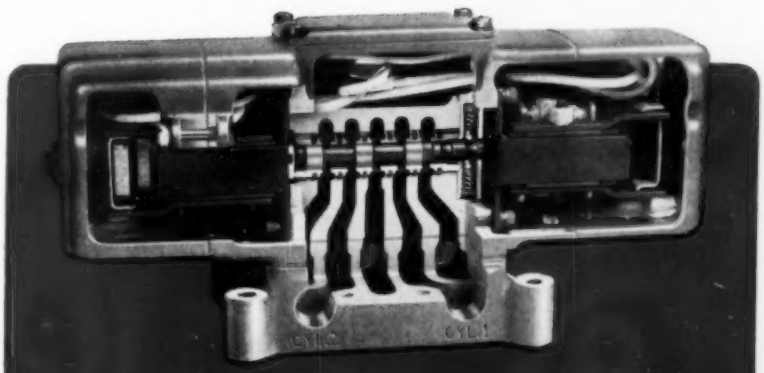
SOLENOID VALVES . . . with single and double solenoid operations are described in two leaflets from Automatic Valve Co. The ½-inch, single-solenoid model and the ¼ and ⅜-inch, double-solenoid models are sub-base mounted and conform to JIC Standards. Recessed pins in the covers permit manual operation without removing the cover. Solenoids are mounted to the cover to make the valve electrically inoperative when the cover is removed. Diagrams illustrate valve operation and exploded views are included to show parts lists.

Circle 209 on Reader Service Card

PRESSURE SWITCHES . . . for pressures to 100 psi which have complete freedom from damage due to high over-pressures and overtravel are specified in Catalog CGC-600 from Century Electronics & Instruments, Inc. Large surge pressures cannot upset calibration of these switches and accurate reliable operation is assured. The reliability and small weight and size is of particular importance in aircraft applications. The catalog gives details on four models with dimensions and specifications.

Circle 210 on Reader Service Card

something NEW!



a BETTER air valve

. . . the SA series

NEW SIMPLICITY . . . a lapped spool sliding in a hardened sleeve provides the valving action—*One moving part.*

NEW RELIABILITY . . . the valve has no moving seals; eliminates wear, sticking, swelling of elastic seals. Gives positive, trouble-free performance.

NEW RUGGEDNESS . . . the SA Series sets new standards for long life. Outwears ordinary valves on every test.

NEW DESIGN . . . full sub-plate mounting, watertight solenoid enclosures, integral junction boxes on all double solenoid models, side ports, bottom ports, O-ring manifold mount . . . all are standard on the SA Series.

The SA Series offers a complete line of actions, single solenoid spring return, double solenoid momentary contact and double solenoid spring centered 4-way actions . . . single and dual pressure versions. 54 different models in sizes ¼" through ¾" pipe. The most complete family of 4-way air valves available.

Get complete information and specifications by mailing the coupon.

NUMATICS, Inc. MILFORD, MICHIGAN

NUMATICS Inc.
106 Main Street
Milford, Michigan

Send me your catalog No. 8000 on the new SA Series Valves.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

Post Scripts of Industry

News about people, manufacturers and sales organizations

Ray G. Holt
Char-Lynn Company

Donald K. Marsh
Adel Precision Products

George L. Ogdin
Fulton Sylphon Division

Ray G. Holt has joined the **Char-Lynn Company** as vice president in charge of products and markets. Formerly general sales manager of the Pesco Division of Borg-Warner Corp., Holt will now direct an expanded marketing program for a recently completed line of hydraulic products. This program will be concentrated within the United States and Canada, and will be carried on through thirty field representatives.

Adel Precision Products, A Division of General Metals Corporation, named **Donald K. Marsh** as sales manager of the Burbank, California plant. Before joining Adel he was aircraft sales manager for General Controls.

McIntire Company, Livingston, N. J., announced the formation of an industrial division to develop and market filters, manual and automatic air, gas and liquid dehydrators for working pressures up to 4,000 psi; water separators and filter assemblies for air, oil, water and various chemicals.

Fulton Sylphon Division, Robertshaw-Fulton Controls Company, promoted **George L. Ogdin** to general sales manager. **David D. Gordon** was assigned as sales manager for the Los Angeles district, which covers California, Oregon and Washington. **W. J. Hajek** was transferred from Los Angeles to Chicago.

Formation of **Mentor Services and Research, Inc.,** has been announced. Organizers of the new company, **D. A. Stark, Oliver Lear** and **Paul Lisby,** also are officers of Fluid Controls, Inc., and Fluid Regulators, Inc. No manufacturing is planned, the company will be devoted to the design and development of new hydraulic products and systems. The manufacture of the products developed will be granted to licensees. Stark will manage the new company, **Joseph Melichar** was appointed chief engineer.

The Weatherhead Company's Aviation Division has named **Robert E. Coleman** as sales engineer on the West Coast. Coleman has been active in the aviation industry for ten years, he was previously a field engineer for Curtiss-Wright.

Conoflow Corporation has expanded its Philadelphia sales office operations. **Harry J. Hartz** was appointed district manager, **William E. Hagan** will serve as district sales engineer. This new branch office, located at 2100 Arch Street, Philadelphia, will cover the territory of eastern Pennsylvania, southern New Jersey and Delaware.

William S. Forrest has been appointed as industrial division sales manager of **National Motor Bearing Co., Inc.** For the past three years he was assistant to the

Continued on page 124

Circle 15 on Reader Service Card

SOLENOID OPERATED AIR VALVES

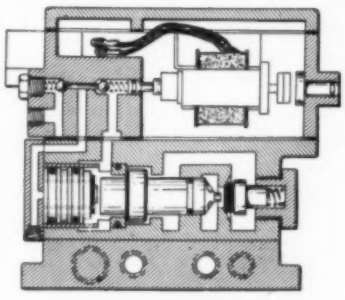
designed to

J.I.C.

standards

1/4" - 3/8" - 1/2" - 3/4"

4-Way—Model 441



FEATURES

A—Manual Operating Button

B—Water-tight and Dust-tight Solenoid Enclosure with built-in Electrical Junction Box.

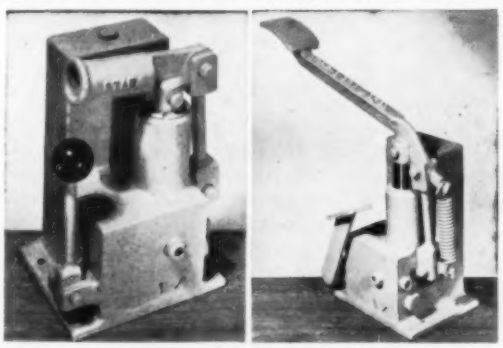
C—Cover chained to Body

Write for Information—Prices

AUTOMATIC VALVE CO.

37419 Grand River Ave. • Farmington, Mich.

STAR Hi-Lo TWO SPEED CONCENTRIC PUMPS



HAND OR FOOT OPERATED WITH SINGLE LEVER OR PEDAL

Two speed construction provides automatic change-over during operating cycle from high speed low pressure to low speed high pressure.

MAXIMUM CAPACITY 10,000 P.S.I.

Safety overload valves—Hard chrome plated pistons—Piston stroke 1½ inch—Oil capacity 150 cu in or larger—5 models: (½"-⅜"), (½"-1¼"), (½"-1½"), (⅝"-1½"), (½"-2¼").

Special engineering counsel and proposals cheerfully submitted on request. Ask for Catalog #555.

Representative areas available

HYDRAULIC AND AIR DRIVEN COMPONENTS — STAR JACK

STAR JACK CO., INC.

420 LEXINGTON AVENUE, NEW YORK 17

PLANT: RIVER GROVE, ILLINOIS

OUTWEIGHED by QUALITY and PERFORMANCE

TEFSEAL by SPARTA TEFSEAL

CUSTOM MOLDED

TEFLON

(DU PONT'S TRADEMARK)

IN THIN SECTIONS AND SHAPES

• CUP, BALL, SHAFT SEALS • WASHERS • GASKETS • DIAPHRAGMS

Custom molded parts in TEFLON are better. TEFLON's unique properties . . . chemically inert, heat resistant, tough, flexible, low coefficient of friction . . . offer YOU important advantages in product design and development.

Are you looking for "that" material which can meet your most rigid requirements to resist temperatures ranging from 500° F. to —100° F.? . . . TEFLON is the answer. Are you having trouble with designing your assembly because of corrosive problems? . . . TEFLON is the answer. Let SPARTA's trained engineers help you solve your problems.

TEFLON can save YOU money

- **Less Maintenance**
- **Less Replacement Cost**
- **Increased Productive Capacity Through Less Down-time**
- **Reduced Wear on Pistons, Shafts, etc.**
- **Simplified Design**

The First Cost Can Be the Least . . . If It Is The Last Cost!

Write today for our new brochure

"SPARTA REPORTS ON TEFLON"

Custom Molding in Thin Sections and Shapes.

Dept. AH

SPARTA MANUFACTURING CO.

DOVER, OHIO

Phone: 4-2755

Circle 103 on Reader Service Card

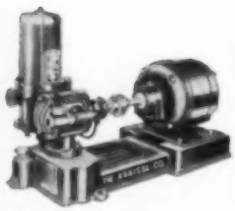
Circle 100 on Reader Service Card

KRAISSL

• Since 1926 • in the application, design and manufacture—pumps, separators, hydraulic accessories.

EQUIPMENT FOR FLUID POWER TRANSMISSION

Primary Oil Pumps • Vacuum Powered Transmission and Low Pressure Air Service • Air and Liquid Filters •



Rotary Air Pumps for vacuum bottling

Kraissl's patented, automatic, force-feed lubrication and flushing system makes these direct-drive, high-capacity pumps ideal for the special requirements of bottle-filling machinery.

Air-cooled design—or water-cooled models for heavier duty.

Class 21 roller-action pumps are recommended for handling corrosive gases and extraneous matter that might jam with closer clearances. The multi-blade design of the Class 25 pumps gives higher capacity efficiencies and is designed for applications requiring higher degree of vacuum.

Where water-cooling is desired for continuous service, the water-jacketed Class 25-WJ models are recommended.

Our exclusive Class 26 design air filter can be furnished as an integral part of each pump, up to 10 cfm—to produce oil-free discharge air and also conserve the lubricating oil.

Write today for Bulletin A-1289, for air-cooled pumps—and for A-1523 for the water-cooled models.

KRAISSL CO

305 Williams Ave., Hackensack, N.J.

Post Scripts of Industry

continued

director of sales. He has had many years of sales management experience and will now direct the division's sales throughout the United States and Canada.

Gene W. Richmond has been assigned to the Chicago sales force of the **International Packings Corporation.** He was previously

Gene W. Richmond
International Packings Corp.

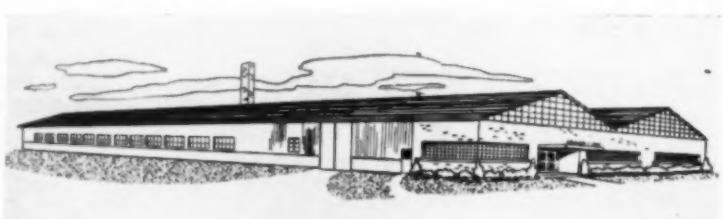
John W. Reedy (left)
John W. Pozerycki
International Packings Corp.

assistant director of sales for the Good Manufacturing Co. **John W. Pozerycki** was appointed plant manager in charge of all production at IPC's Bristol, N.H., plant. **John W. Reedy** was named quality manager. The company also announced the acquisition of 70 acres of land in Central New Hampshire for future expansion. The new property is about one mile from the present plant and it is expected that a new building will be eventually erected to house all the facilities.

R. A. Mueller and Associates, Cincinnati, Ohio, and Louisville, Kentucky, have been appointed factory representatives of the **R. P. Adams Company, Inc.** The Cincinnati offices will cover the southern section of Ohio, while the Louisville office will serve the northern part of Kentucky.

Pesco Products Division of Borg-Warner Corp. has announced the appointment of **Robert G. Hess** as executive vice president. Hess joined Pesco in January 1955 and was vice-president-operations. Prior to joining Pesco he had been general manager of the Watertown (N.Y.) Division of New York Air Brake Co.

Mechanical Air Controls, Inc., named two new sales and service representatives. **J. Neill Armstrong, Inc.,** New York City, to cover the New York City area, and Fred McAvoy, Grand Rapids, for the Western Michigan territory.



Hydro-Line Manufacturing Co., Rockford, Ill., is completing construction on a new addition to their Rockford plant. The new facilities, designed to house added production equipment, doubles the previous production area. Further expansion of office and engineering space will begin in the near future.

Charles S. Hempelman was named market analyst for the **Le Roi Division, Westinghouse Air Brake Co.** His duties will include evaluation of the company's present markets and research and analysis of new markets for existing or new products developed by the division.

Formation of two new companies, **Taylor Devices, Inc.,** a manufacturing Company and **Tayco Developments, Inc.,** a research company, North Tonawanda, New York, was announced by **Paul H. Taylor,** president. They will manufacture and develop compressible material devices for the aircraft, automotive and machine tool industries by utilizing the unique compressibility of special liquids.

Paul H. Taylor
Taylor Devices, Inc.

Lloyd Van Buskirk, Jr. has joined the **Electro Dynamic Division of General Dynamics Corporation** as Detroit district manager.

Square D Company and **Electric Controller and Manufacturing Company** have begun operations as a merged corporation. Square D will operate Electric Controller as a separate division. **F. W. Magin** has become chairman of Square D's board of directors and **A. G. Patterson** was named president. **Dr. John D. Leitch** and **Alvin C. Dyer,** vice presidents and directors of Electric Controller were named to similar posts in the merged company. Electric Controller will remain in its recently completed plant in Cleveland.

Robert E. Peterson joined the Pittsburgh office of **Clark Controller Company** as district application engineer. He was previously associated with the Monitor Controller Company.

Robert E. Peterson
Clark Controller Co.

Herbert H. Schmiel is the new chief engineer of the Industrial Hydraulics Division of the **Parker Appliance Company.** Before coming to Parker as assistant chief engineer, Schmiel was associated with the Hydreco Division of New York Air Brake Company, where he specialized in pump and valve design engineering.

The appointment of **Carl E. Gunther** as chief engineer of **Waterbury Tool,** Division of Vickers Incorporated has been announced. He was previously director of research and engineering, Fuller Brush Co.

Carl E. Gunther
Waterbury Tool

W. M. Pattison Supply Company, Cleveland, Ohio was appointed an authorized distributor for equipment manufactured by **Worthington Corp.**

Continued on next page

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Model 2 Phase Comparator

...can be used as a modulator, demodulator or switch

This compact, rugged comparator is hermetically sealed in an inert gas and packaged for mounting in a standard octal socket. Two full-wave bridge rectifiers are used to obtain a high degree of stability and balance.

As phase sensitive comparators, these units can be used to measure the amplitude or phase of an input signal with respect to a reference signal. As demodulators, DC output can be obtained either single-ended or push-pull with respect to ground. Suitable for all military applications.

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Frequency Response: 0 to 5000 CPS; ***Max. Reference Voltage:*** 120V. RMS; ***Max. Output Voltage:*** ± 50V. DC; ***Dynamic Range:*** 46db; ***Load:*** Max. 200K ohms, — Min. 20K ohms; ***Input Impedance:*** Approx. 200K ohms with 200K ohms load and 1:1 transformer. ***Size:*** 1″ dia. x 3″; ***Weight:*** 2 ozs.

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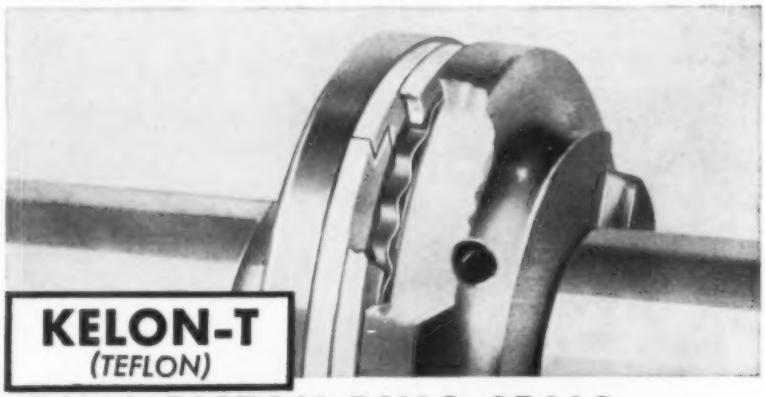

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AMERICAN HOLLOW BORING COMPANY
1954 Raspberry St., Erie, Pa.

Post Scripts of Industry
continued

Valvate-Associates, Huntington Park, California, were appointed authorized stocking distributors for the **Automatic Switch Company.**

James M. Ayers has joined the **Rucker Company** as sales engineer for the San Francisco and Peninsula territory. Also announced was the transfer of **Donald A. Anderson,** who was promoted to district application engineer for the Los Angeles area.

James M. Ayers
The Rucker Company

Donald A. Anderson
The Rucker Company

Ira L. Kasindorf was promoted to chief development engineer of the **Eastern Components Division of Servomechanisms, Inc.**

Glidden Engineering and Equipment Company, representatives for Automatic Switch Company, has moved their offices to 211 Diane Street, Douglas Park, Jefferson Parish, Louisiana.

Circle 8 on Reader Service Card

Char-Lynn Company has appointed the **Fornaciari Company,** Los Angeles, as representative for the southern California area.

Paul Fornaciari
Fornaciari Company

Paul Fornaciari is general manager. The firm incorporates a newly organized hydraulic engineering department devoted to design and application problems.

Blair-Martin Company, Inc., South Pasadena, California has been appointed exclusive representative of Anderson, Greenwood & Co., for the states of Arizona and California. **Frederic D. Blair,** president, was formerly regional sales manager of Aerol Co., Inc. **Walter S. Martin,** secretary-treasurer was chief sales engineer of the same company. **William B. Morgan** was sales engineer with the Robert H. Brown Co.

Controlled Rubber Products, Inc., newly organized manufacturing and custom engineering firm in the precision molded rubber field have opened a new plant in Willoughby, Ohio. Head of the company is **Warren J. Sackett.**

J. Warren Sackett
Controlled Rubber Products, Inc.

Continued on next page

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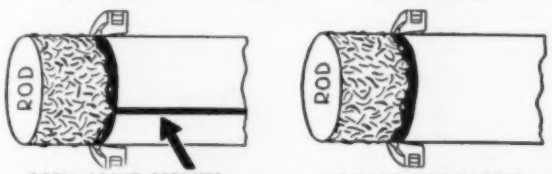

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Spec Mil-S-5049, AN Approved, Military part numbers from AN6231A1, 1/2", to AN6231A71, 13", diameter. This ring consists of 3 pieces assembled into one . . (1) a one-piece Split Wiper Ring (Body) with 2 flanges or groove in its O.D.; (2) a one-piece split compressor spring assembled in groove (3) an endless cover band surrounding spring in groove which causes squeeze grip action on piston rod.

Squeeze Grip Action Does It—patented

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Ace Products Co., Toledo 1, Ohio
Phone Cherry 36513

Fall Wiper Ring SPRING LOADED

Covered by patents issued and patents pending.

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Circle 2 on Reader Service Card

Post Scripts of Industry
continued

Northrop Aircraft, Inc., Hawthorne, Calif., has begun work on a facilities consolidation program which includes construction of one of the world's most advanced scientific engineering research centers. This new 250,000 square feet, multi-million engineering center will be dedicated to the advancement of aeronautical progress. The facilities will include an engineering test laboratory, a low-speed wind tunnel, jet engine test facilities and research laboratories. The new structures will replace temporary buildings erected during World War II.

As a result of an exchange-of-stock agreement between **Conoflow Corporation** and the **Walworth Company,** Conoflow has become an operating subsidiary of the Walworth Company. The merger will provide Conoflow with a broader financial base to expand research and development activities and acquire additional manufacturing facilities. As an independent subsidiary, Conoflow will operate under the same policies as in the past, at its existing plant, with no change in management or personnel.

Hope Rubber Co., of Fitchburg, Mass. opened a branch at 47 Airport Rd., Hartford, Conn., and will handle tube and hose fittings made by **Parker Appliance Co. Walter J. Magee** is in charge of this new branch.

Robert R. Johnson, newly appointed chief engineer for **Minnesota Rubber and Gasket Company,** will be in charge of all engineering operations. He was previously general manager of Master Tools, Inc., a subsidiary of Minnesota Rubber.

American Engineering Company has moved its main offices to a newly completed office

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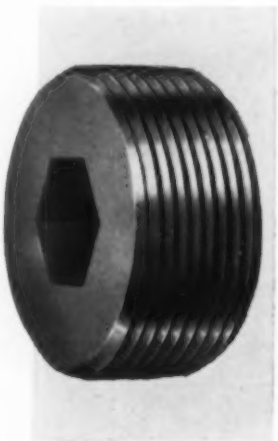
UNBRAKO

Dryseal-thread Pressure Plugs for hydraulic or fuel systems



Use them wherever liquids or gases must be contained under pressure—or in place of ordinary pipe plugs. UNBRAKOs seal without compound. They are made of the same high-strength alloy steel, have the same internal wrenching feature as UNBRAKO socket screws. Fully formed threads exceed NPTF specifications. Standard sizes—⅛ to 1¼ in.—are stocked by your authorized industrial distributor. See him for details. Or write Unbrako Socket Screw Division, STANDARD PRESSED STEEL Co., Jenkintown 2, Pa.

UNBRAKO SOCKET SCREW DIVISION

STANDARD PRESSED STEEL CO. SPS JENKINTOWN PENNSYLVANIA

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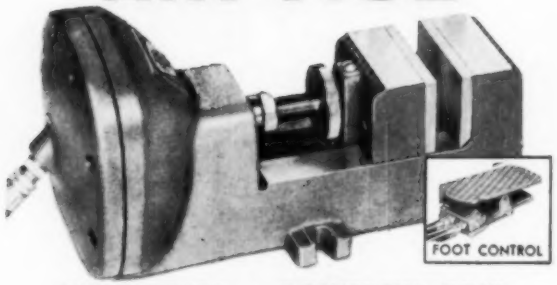
Speedy

AIR VISE



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Does the work of expensive presses! Power factor 15 times air line pressure. 5-inch throat; Ram 0 to 5"; stroke ⅝"; table 5" x 5". Operated by foot or fingertip controls. **$85.00**

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building in the Frankford district, at Wheatsheaf Lane and Sepviva St., Philadelphia. The company's Frankford plant has been enlarged substantially. The new arrangement brings together all activities of the organization.

Rivette Lathe & Grinder, Inc., has appointed the **H. A. Jones Company,** Dayton, Ohio, as their representative for the Dayton-Cincinnati area. **Harry A. Jones,** president of the company, was formerly general sales manager for Gerotor May Corp.

L. J. Morris has been assigned as assistant district manager at Pittsburgh for **Tube Turns, a Division of National Cylinder Gas Company.** He succeeds W. C. Robinson who has become an assistant sales manager in the company's Eastern Division. **T. T. Thompson** was added to the Pittsburgh sales staff.

Resistoflex Corporation, formerly located at Belleville, N. J., has moved to its new plant and research facility at Roseland, N. J. The 55,000 square feet completely modern structure doubles the company's former capacity and a substantial addition to the new plant is already under construction.

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HYDRAULIC CYLINDERS

Attention: O. E. M.
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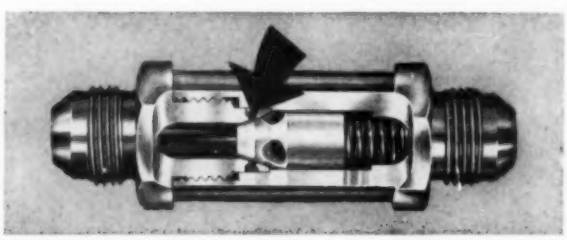

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CHECK VALVES
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Stop Air Blast and Noise!

Want to get rid of annoying air blast, excessive noise? Just install inexpensive MODERNAIR Air Exhaust Mufflers in the exhaust ports of your air valves. Simple, rugged, non-corrosive — nothing to lubricate or maintain. Made for ¼" and ⅜" NPT port sizes; only 4-3/16" long, 1" diameter. Price, $2.75 each. See your MODERNAIR distributor or write us today.

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These jobs offer more than engineering adventure. There's common-sense practicality involved, too. Electric Boat's backlog of orders and years-ahead plans; its record stable engineering employment; its sponsorship of advanced study at leading universities and within the plant are some of the practical features. New England living on the shores of Long Island Sound is another.

To find out more details about these opportunities, write us details of your background and experience including initial salary requirements. Interviews will be arranged promptly for qualified applicants. Please address **Peter Carpenter.**

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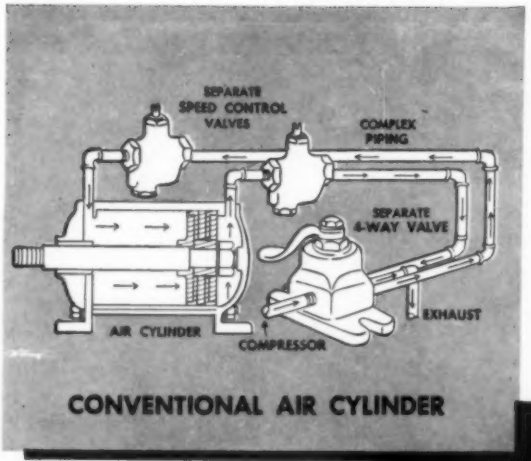

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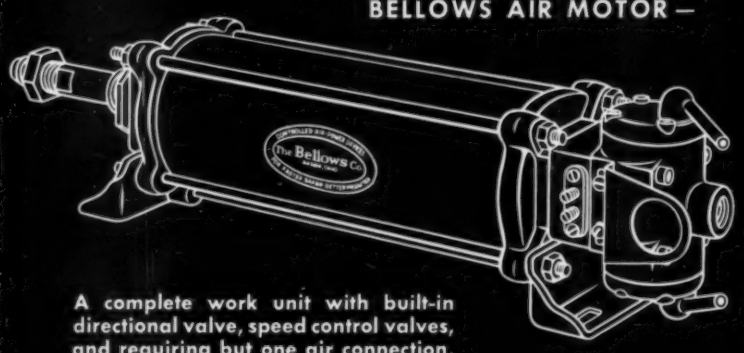

A complete work unit with built-in directional valve, speed control valves, and requiring but one air connection.

Design engineers looking for simplicity and economy in air circuit installations will find a quick answer in the two circuits sketched in this ad. One shows a conventional air circuit with separate air cylinder, separate speed control valves, separate directional valve and the piping required to install the circuit. The other shows the Bellows Air Motor—the complete air cylinder package—with directional valve and speed control valves built in, and its single air connection.

But simplification of design and installation problems is actually one of the less important advantages this compact power unit offers. The big advantages are precision control and improved performance. Response is lightning fast; action is smooth and positive. And coupled with improved performance is minimum maintenance —less time out for servicing.

The Bellows Air Motor offers you a choice of *built-in* directional valves: 8v or 110v electrical control, explosion-proof electrical control, manual control, or pilot valve control—in five bore sizes: 1″, 1¾″, 2½″, 3⅝″ and 4½″, and in any stroke length.

This new four-color, 24-page bulletin gives full technical data on Bellows Air Motors.

It is free on request. Ask for BM-25. Write Dept. AH-456, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto.

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